THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

Vol. LIX.] CONTENTS: September 14, 1906. [No. 1,503.

	Page
Pushing the Sale of Electricity	401
Accurate Speed, Frequency and Acceleration Measurements (*illus.*) (*concluded*)	403
Electric Power Signalling on the New York Central and Hudson River Railroad (*illus.*)	404
Oerlikon Single-Phase Locomotives (*illus.*)	406
Correspondence	408
Evershed's Patent Bridge Megger (*illus.*)	410
Organising the Sale of Electricity	411
Enclosed Magazine Fuse Box (*illus.*)	415
Power Transmission Lines (*illus.*)	415
Business Notes	417
Electricity Supply Accounts	426
City Notes	427
Electric Tramway and Railway Traffic Returns	428
Stocks and Shares	428
Share List of Electrical Companies	429
Earth in Collieries	431
A Chat about Steam Turbines	432
Reviews	434
Electric Pumping at Collieries	436
Electrolytic Manufacture of Sodium Hypochlorite	436
American Telephones and Telegraphs in 1902	437
The Future Régime of Electricity in Paris	439
The South Shields Electric Tramways	439
New Patents Applied For	440
Published Specifications	440

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PUSHING THE SALE OF ELECTRICITY.

"WANTED! A Commercial Assistant." Advertisements headed thus and emanating from electric light and power supply companies and municipal electrical departments are becoming more frequent. It is a development that is already well overdue, but now that it has arrived we will not waste time weeping over what might have been had it come earlier, for practically everybody agrees that commercial energy and initiative in pushing the sale of electricity have been sadly lacking in far too many places until recently. Now there appears to be an awakening in progress which seems to be more or less general, and we have to see that there is no further slumbering or lazing.

Some weeks ago, in some references to the importance of this question, we remarked that as electricity supply undertakers on both sides of the Atlantic had both alike been stirred up to greater business-getting activity, though the conditions prevailing in the two countries differed widely in many respects and called for different procedure, it would be as well for us to watch the various ideas put forward there, and to see whether they could be profitably applied to English conditions. We have noted that some of our American exchanges have regarded the papers on the commercial development of electricity supply that were read before the Municipal Electrical Association meeting as being of interest on that side of the Atlantic, and we now take the opportunity of placing before English readers an American view of the new position of affairs, and some suggestions as to the best methods for dealing with it. This will be found in later pages of this issue in the form of a paper prepared by Mr. M. S. Seelman, jun., under the title "Organization and Conduct of a New Business Department Suitable for Central Stations of Cities of 50,000 Population and under." This paper was submitted in competition to the Co-operative Electrical Development Association of Cleveland, Ohio, which last March invited all central station managers and their commercial employés to compete for prizes of £100, £60 and £40 respectively. Mr. Seelman, who is engaged with the Edison Electric Illuminating Co., Brooklyn, was the winner of the first prize, and we are indebted for our reprint to our New York namesake, which congratulates the author upon the simplicity of his treatment of the subject, and the practical nature of his suggestions. The Association, we understand, intends to give full publicity in the Press to the other prize-winning papers, and also to four which received honourable mention; later on, the whole will be distributed in pamphlet form. In view of the present interest centring round the movement there is certain to be a demand for these pamphlets in this country as well, as soon as they are available.

Gas Engine Progress.

In a paper presented to the Western Society of Engineers, Mr. C. E. Sargent deals with the status of the gas engine in the United States in a manner which shows the interest now being taken in the subject.

The first cost of a large gas engine plant, all included, is not less than that of a complete steam plant, but the large gas engine is practically as durable as the steam engine, while stand-by losses are less; and the case is quoted of two producers of 200 H.P. belonging to the Erie Railroad Co., in one of which the fire has never been out for seven years.

Why, it is asked, when a given quantity of energy can be generated by the use of 10,000 B.TH.U. in gas engines, should 40,000 B.TH.U. still be used? and why continue burning 400 cb. ft. of waste gas under boilers when the same work can be done by 100 cb. ft. in gas engines? The answer is, and it applies unfortunately with greater force in Great Britain, that manufacturers have not kept pace with gas engine progress.

With tandem construction on the two-cycle system a single crank will receive as many impulses as in a single-cylinder steam engine, and with twin tandem as many as in a cross compound, and with this twin tandem type the problem of driving polyphase electrical generators in parallel is considered to be solved.

The author seems to advocate heavy fly-wheels to secure the minimum angular velocity variation demanded for the parallel running of alternators, but he does not refer to the difficulty of synchronising, which is held by some to attach to heavy wheels. He illustrates an angle-meter for the purpose of showing the variation of angular velocity of a fly-wheel, each degree of departure being multiplied 360 times, so that the needle of the instrument swings through a complete circle for each degree of irregularity of the engine driving it. This instrument consists essentially of a fly-wheel driven by an inelastic belt from the engine through the medium of a hair-spring.

In the course of the discussion, a speaker suggested that the large gas engine had been born 10 years too late, and that the steam turbine would practically stop it. Undoubtedly the steam turbine has done much to check the gas engine, and there is little present hope or prospect of utilising the turbine principle for gas engines. But the steam turbine has by no means the fuel economy of the gas engine, and the existence of a huge output of waste blast furnace gas cannot fail to keep in men's minds the problem of using it. Fuel economy will keep alive the reciprocating engine, for this engine is the only one that can yet use gas as its source of heat by way of internal combustion.

The same speaker considered that the gas engine, however, was ahead of the producer. Mr. Thwaite's latest producer is of considerable height and is blown like a blast furnace, and fluxed with lime, so that the ash and clinker are run out of a tap hole in liquid form. Mr. Thwaite has, in fact, gone back to the blast furnace for his pattern of producer, much as he went to the blast furnace for power, because it produced a steady volume of waste gas similar in quality to the gas made by the best producers.

Thus the gas producer is now continuously workable, exactly like the blast furnace, with liquid slag, and the trouble of clinkering is abolished, together with the resulting irregularity in quality and quantity of the gas. Needless to say, the giving of height to a producer is for the purpose of enabling the fuel to consolidate more perfectly, and thus avoiding gaps, caves and short circuits of the air supply which are almost inevitable with shallow producers, especially when coke is employed, the specific gravity of which is too small to effect proper consolidation of the fuel.

Engineering at Olympia.

To-morrow, Saturday, 15th inst., will witness the opening of the Engineering and Machinery Exhibition, for which preparations have been in progress at Olympia for several weeks past. The necessary formalities connected with the inauguration of the show will be performed by Sir Alexander R. Binnie, President of the Institution of Civil Engineers, who at one o'clock will make a tour of the Exhibition, subsequently declaring it open. An inaugural luncheon will follow. Engineering is becoming a more and more popular subject with the general community, but it is not to be supposed that an Engineering Exhibition is likely to possess the glamour that draws the public to an Electrical Exhibition. Last year's Electrical Exhibition was run chiefly for the purpose of popularising the uses of electricity among the general populace, and exceptional measures were taken through the co-operation of representative electrical bodies to ensure the attendance of those who were likely to be the most interested. We all know how successful that show was from all points of view. Now it seems to us that this Engineering Exhibition is of a somewhat different character. It will appeal to the trade, to buyers, to all classes of engineers, and to students, and as an engineering trade show we think success can be foretold. Electrical engineers who can make an opportunity to visit the Exhibition before it closes on October 15th should do so, for steam and general engineering plant and apparatus have a large place in every electrical installation, and a few hours spent in searching among exhibits for the things which may lead in the direction of obtaining greater efficiency, economy and convenience in general working, are time profitably spent. For the interest of electrical men, we may add that the Electrical Review has a stand at this Exhibition, where we should like the opportunity of a hand-shake.

Hamilton, Ohio!

"Many failures and few successes" are the words in which an over-sea contemporary sums up American municipal electrical experience. Investigations instituted in this country by the Local Government Board and by the Press have led to remarkable exposures regarding the practices to which the representatives of the public will stoop in their pretended safeguarding of the interests of the ratepayers. The tendency towards extravagance and corruption, with the consequent increasing burden of high rates, have had an educative effect upon the public mind, which we venture to believe will show itself when the next municipal elections take place. But, unsatisfactory as much of our municipalisation has been, we do not think we can point to an example where "mismanagement, extravagance and unbusinesslike methods" have exceeded those which have been permitted in the case of an American city which our contemporary singles out as one of the latest instances of failure. It appears that Hamilton, Ohio, with a population of 25,000 to 30,000, has had a £20,000 electric lighting plant in operation for 12 years. The State auditor has made a report, and he finds that inexperienced men have been called in to superintend important work "where both mechanical and electrical skill were necessary." Faulty construction has led to enormous waste of energy, and the raising of the cost of production to an abnormal figure—above that charged to the public. So far stated the record might be due to ignorance and municipal mismanagement. But there is something more —"officials, ex-officials, prominent citizens and others were enjoying free service . . . . no effort had been made toward collecting the accounts." Indeed, at the beginning of the year some £7,000 was outstanding for such accounts—an amount equal to a full year's gross revenue! This sort of

procedure we need not characterise, but it would need a stronger term than ignorance or incompetence.

Hamilton, Ohio, provides a strong argument for Americans against municipal electrical enterprise, and it also serves to emphasise the necessity of a most efficient system of State inspection and account auditing in connection with public works wherever carried out with public moneys. But for the intervention of the State auditor, Hamilton might have cuddled itself up in corruption for many a long day. How its Councillors must shrink before the light of publicity!

Electrical Production of Steel.

The system of producing steel by the Héroult process, as practised at the works of R. Lindenberg, at Remscheid, is expected to have an important influence upon the German iron and steel industry. At present most qualities of special steels and alloys of steel which are intended for the manufacture of tools, knives, saws, arms, &c., are produced in Germany on the crucible smelting process, which consists in the smelting in graphite crucibles of very pure raw material in quantities of from 66 lb. to 1 cwt., which is largely obtained from Sweden or Styria. The steel produced in this way is very dear, as the raw materials alone are stated to represent a value up to £17 10s. per ton, and the smelting expenses of from £4 to £5 per ton have to be added. The Héroult process is, however, less dependent upon the quality of the raw materials, as it is possible with existing metallurgical methods to reduce the injurious phosphorus and sulphur contents to less than one-hundredth of 1 per cent. As practised at Remscheid, scrap iron and steel are melted in one furnace and then transferred in a liquid condition to the electric furnace, which has a capacity of from 1½ tons to 2 tons, and in which the metal is treated with two different kinds of slag, which mainly contain lime. After the purification has been carried out in this way, the materials are added which are necessary for the production of the particular quality of steel required, as, for instance, carbon, manganese, silicon, nickel, chromium, tungsten, and so forth. The purification and making ready occupy from two hours to two hours and a half. The consumption of energy in the case of a furnace of 1½ tons capacity amounts to 360 KW.-hours per ton of finished steel, but with a larger furnace of 10 tons capacity, it is assumed that it would only reach 150 KW.-hours per ton of steel. It is considered that if worked on a large scale under the labour conditions prevailing in Germany, it would be possible to manufacture steel equal to the average quality of crucible steel for the small sum of £5 per ton. The German technical view of the question is that the process will not only render the country independent of others in the matter of special steels, but will also allow of the production of an article which will meet all requirements at less than half the cost of equal qualities hitherto produced, while the almost complete elimination of sulphur at the works at Remscheid is said not to be possible by any other electrical method now in operation.

"**The Electrical Bulletin.**"—We have been favoured by Mr. Spencer Hawes, M.I.E.E., the editor, with an advance copy of the first number of this publication, which is a penny quarterly budget of information for electrical users. It is the intention that the various uses and applications of electricity shall be treated in some detail in a popular style appealing to the general public, and at the same time imparting useful information for all classes of consumers. We hope that it will find its efforts rewarded by the greater prosperity of the 13 London electricity supply companies on whose behalf it is published, and to that end by the wholesale bringing on of new consumers who at present, for reasons over which they have control, are groping in the dark.

ACCURATE SPEED, FREQUENCY AND ACCELERATION MEASUREMENTS.

By CHARLES V. DRYSDALE, D.Sc.

(*Concluded from page* 365.)

Acceleration Tests.—These may be taken with the greatest accuracy and convenience by noting the instants at which the successive figures become stationary when the diagram in fig. 3 is observed through the slits of the fork. Fig. 6 shows curves representing the variation of speed with time on switching off a 4-B.H.P. Langdon-Davies motor running at 3,000 R.P.M., both when light and when various

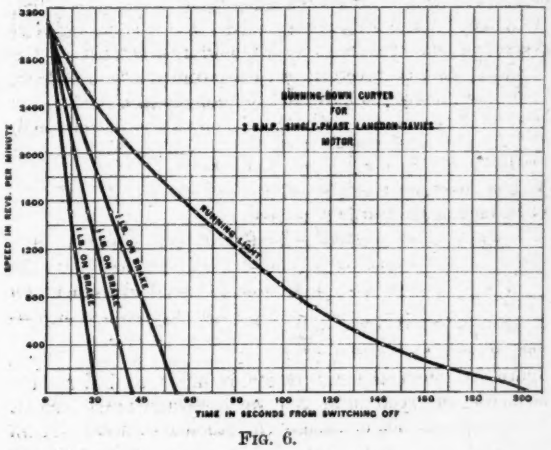

RUNNING DOWN CURVES FOR 3 B.H.P. SINGLE-PHASE LANGDON-DAVIES MOTOR
SPEED IN REVS. PER MINUTE
TIME IN SECONDS FROM SWITCHING OFF
RUNNING LIGHT
1 LB. ON BRAKE
1 LB. ON BRAKE
1 LB. ON BRAKE

Fig. 6.

torques are applied to it by a brake, and it will be seen that the observations lie on the curves with remarkable regularity. This is probably the only method which would enable such curves to be accurately obtained, owing to the fact that other speed indicators either introduce sufficient friction appreciably to affect the machine when running light, or, on the other hand, lag behind variations of speed when these are at all rapid. Fig. 7 shows the curves of rise of speed in starting the motor light and on a brake, and is of interest as

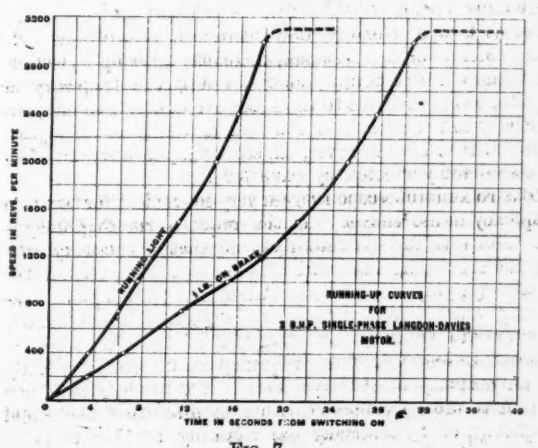

RUNNING-UP CURVES FOR 3 B.H.P. SINGLE-PHASE LANGDON-DAVIES MOTOR.
SPEED IN REVS. PER MINUTE
TIME IN SECONDS FROM SWITCHING ON
RUNNING LIGHT
1 LB. ON BRAKE

Fig. 7.

showing that it is thereby possible to compare the starting properties of various motors and starting devices, and to determine the torque at any moment during the whole period of acceleration, when the friction and moment of inertia have been determined from the running-down curves in the well-known manner. Calculations made from these curves show that the moment of inertia of the rotor is ·106 lb. ft. units, that the loss due to bearing friction is ·032 H.P. or ·8 per cent., to windage at 3,000 revolutions ·19 H.P., or 4·7 per cent., giving a total frictional loss of ·221 H.P., or 5·5 per cent. of the output. They also show that at starting the acceleration is about 14 radians per second, which, with

the above value of the moment of inertia, implies a starting torque of 1·5 lb. ft. This torque is fairly constant up to about 1,800 revolutions, after which it rapidly rises to about 3 lb. ft. on nearing synchronism.

Observation of Cyclic Irregularity or Hunting.—Another valuable application of the stroboscope is in all cases of irregularity of speed. These variations are of two classes—those which take place during a single revolution, and those which extend over a period of several revolutions. The former are expressed by the term cyclic irregularity, and in this case the shaft does not travel through equal angles in equal times. By means of a roller stroboscope, in which the time between the flashes may be made any exact fraction of the time of a revolution, and using a single radial white line on a black background attached to the shaft of the machine under test, an appearance will be seen like the spokes of a wheel, which spokes are at regular intervals if the speed is uniform. This appearance can be photographed, and if any cyclic irregularity exists, the angles between successive spokes will be unequal, and the amount of the irregularity can be ascertained by a protractor.* Hunting, on the other hand, is indicated by oscillation of the figure when the flashes are a definite fraction of the mean speed, and may be readily expressed by the periodic time and amplitude of this oscillation of the figure. As the conical device enables the mean speed to be exactly balanced, the oscillation can be readily measured.

Frequency Measurement.—The most convenient of the devices for measuring frequency are those depending on the principle of resonance. The first practical instrument on this principle was the well-known frequency meter of Mr. A. Campbell, while the Hartmann, Kemf or Frahms arrangement, in which a number of tuned reeds are actuated by a magnet fed from the A.C. mains, is likely to become the standard commercial instrument for frequency measurement. An ingenious device in connection with the Hartmann-Kemf instruments, which does not seem to be well known, is that known as the transposition circuit which doubles the range. This is effected by a second winding which can be fed with D.C., thus polarising the magnets and causing them to attract the reeds only once instead of twice per period.

Of other frequency meters the only one worthy of mention is the Westinghouse, which takes advantage of the dependence of the choking-coil effect upon frequency. A light aluminium disk is pivoted in the fields of two shunt-wound shaded pole magnets. One of these circuits is practically non-inductive, the other as inductive as possible. Each of these magnets alone would drive the disk round, and they are set so as to oppose one another, while one side of the disk is cut eccentrically. The disk, therefore, takes up a position for which the two forces balance, but if the frequency is increased the force due to the inductive circuit becomes less relatively to the other, and the disk moves to another position. One would, however, expect such an instrument to be considerably affected by wave form.

The roller stroboscope is again very convenient for accurate frequency measurement. If the roller is running in synchronism with the standard fork, all that is necessary is to provide the rolling disk with a figure of the correct number of arms (usually six), and to illuminate it with a thin filament glow lamp from the source of supply. The disk has then only to be traversed along the roller until the cross appears stationary, and the frequency can be read off directly to an accuracy of $\frac{1}{10}$th per cent. Frequency meters can also be accurately calibrated either by measuring the actual frequency, or by observing the vibrating reed through slits in the rolling disk, and traversing the latter until the reed appears to be stationary.

Measurement of Slip.—This again can be done with the greatest precision with the roller device. The roller is only to be run in synchronism with the source of supply, and the figure on the motor shaft viewed through the slits in the rolling disk. On traversing the latter until the figure appears stationary, the percentage slip can be directly read off.

* The maximum amount of cyclic irregularity can also be seen by the amount of blurring of a radial armed figure, provided that the amount of displacement due to the cut-off of the fork not being instantaneous is known.

Fig. 8 shows the relation between torque and slip determined in this manner for a monophase induction motor. The readings were taken with the greatest ease, and as the curve shows, only in one instance did the error of observation exceed one-tenth of 1 per cent. over a range of from + 14 to — 8 per cent. slip. There is probably no other method by which such a curve could have been obtained.

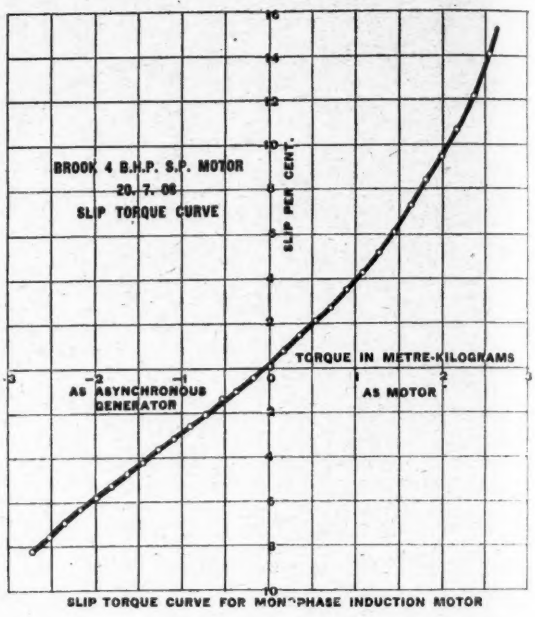


Fig. 8.

It will thus be seen that the stroboscope is a convenient and accurate device for the measurement of speed, acceleration, frequency and slip. Its principal advantages over all other methods are in its being independent of calibration, without lag, and in requiring nothing to be driven by the machine under test. It is also available for many other tests, but these must be reserved for a further article.

It should be mentioned in conclusion that although these stroboscopic methods appear at first sight somewhat delicate, and suited rather for physical research than for engineering test rooms, this is by no means the case. In most instances where anything beyond the roughest measurement is required, it will be found more convenient to use a stroboscope than any other speed measuring device.

ELECTRIC POWER SIGNALLING ON THE NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

The electrification of the New York Central and Hudson River Railroad from the Grand Central Station to Croton, a distance of about 85 miles, and from Mott Haven to White Plains, a distance of about 19 miles, has provided an opportunity for the installation of an interesting system of signalling, some particulars of which are given in the *Electrical Review* of New York of June 23rd. The lines between the places named constitute the so-called "electric zone" of the New York Central and Hudson River Railroad, and are in process of equipment for electric traction. Energy for this purpose is generated at two power stations, situated at Port Morris and Yonkers respectively, as three-phase alternating, at 11,000 volts and 25 cycles. The supply is transformed to direct current at 666 volts at sub-stations situated along the lines, and delivered to the third rail for collection in the usual way. Storage batteries are also provided in the sub-stations for use in connection with the operation of traffic. The work undertaken includes

also the operation of signals, track circuits, signal lights, indicators and interlockings from the same general supply as that for traction, and is of a most interesting character.

The power supply for the operation of the signals, &c., along the lines is single-phase alternating, transformed by special transformers in the sub-stations, and delivered to special signalling mains at 3,000 volts. Each sub-station gives supply to points half way between it and the adjoining sub-station, and the supply to each section is independent of all other sections. The 3,000-volt signalling transmission line is of bare copper, carried on the pole line used for the main supply. For the operation of the signals, their lighting, &c., the pressure is reduced from 3,000 to 50 volts, the transformers being fixed on the signal bridges, or on the

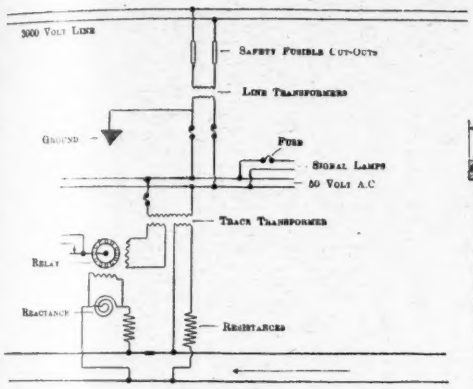


Fig. 1.

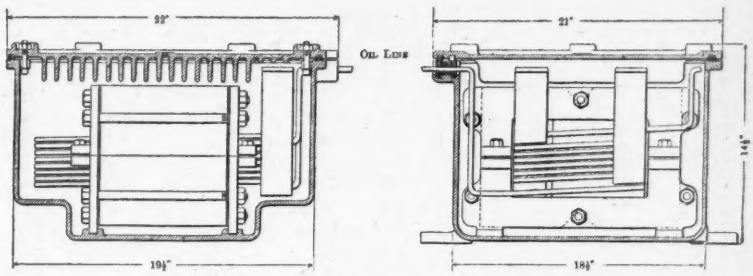


Fig. 3.

poles of the transmission line, as may be most convenient. For the operation of the track circuits the pressure is further reduced, to values varying between 1½ and 8 volts, according to the lengths of the track circuits. The transformers for the track-circuit supply are constructed with four tappings by which the various pressures required may be obtained without the necessity of providing more than one type of transformer. In order that failure of the alternating supply shall not cause a breakdown of the signalling arrangements, special D.C. to A.C. motor-generators, taking their supply from the storage batteries, are provided in the sub-stations, and furnish an alternative A.C. supply to that obtained from the transformers.

The block sections vary in length from 1,200 ft. for speeds of not more than 45 miles an hour, and 2,500 ft. for speeds not exceeding 60 miles an hour, to 3,000 ft. for

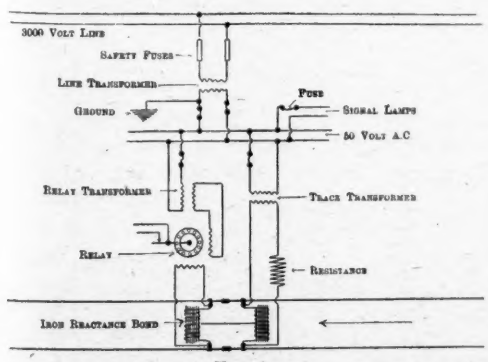


Fig. 2.

speeds exceeding the latter figure. The average length of the longer sections is about 3,200 ft. Distant signals are provided for each home signal, and each block has a full block overlap. There are four tracks over the full distance of each of the sections named above, and there will be about 1,400 track circuits, aggregating nearly 250 miles.

The type of signalling to be installed is the "Young system," and the work is being carried out by the General Railway Signal Co. Probably the chief feature of this application of the system is the double duty obtained from the track rails, which may, partly or wholly, be used for carrying the direct return currents for the traction supply, and at the same time carry alternating currents for the operation of the track circuits, without interference. This object is attained by the interpolation of reactance bonds between the track rails, which offer very little resistance to the direct currents, but oppose the passage of the alternating currents for the track circuits.

Two arrangements of the track circuits are made use of. For track circuits of 500 ft. or less, and where the "drop" in the track rails due to the D.C. traction currents is less than 50 volts, one of the track rails is sectionised and given up to signalling purposes, the traction currents being carried by the other rail, which is continuous. This arrangement is shown by fig. 1, which is self-explanatory. The insulated joints in the track rail are "Weber" joints, with a steel angle plate in the inside.

The track circuit relay controlling the signals is of the induction motor type and has two field coils, one of which is fed from the 50-volt supply, and the other, in which is connected a reactance coil for obtaining a displacement of phase, is fed from the alternating supply in the track rails. The rotor of the relay turns through an angle of $37\frac{1}{2}°$ when under operation, and the break between the contacts of the relay is $23\frac{1}{2}°$. As contact is made during 14° of revolution of the rotor, a good rubbing contact is made. The rigid contact is of a very hard carbon, and the moving contact is of platinum. Sparking at the relay contacts is very slight, notwithstanding the fact that the power required to operate the signals is from $\frac{1}{8}$ to $\frac{1}{4}$ H.P.

For track circuits more than 500 ft. in length, where both rails are used as the return for the traction currents, the arrangement of the reactance bonds shown by fig. 2 is made use of. For sections of not more than 1,600 ft. the reactance bonds are fixed at the ends of the sections, as shown by fig. 2. As the engineering department of the railroad company requires cross bonding of rails at distances of not more than 1,600 ft., track circuits exceeding this length have to be provided with additional bonds. In these cases an ironless reactance bond is preferred. The construction of the bonds is shown in fig. 3. The water-tight cast-iron boxes containing the bonds are filled with oil, and each bond is designed to permit of the continuous passage of 3,000 amperes for each rail of the track without injurious heating.

The signals will be operated by single-phase alternating-current motors wound for 50 volts, and developing about $\frac{1}{4}$ H.P. The signal lamps are 50 volts, 4 C.P., with the filament wound in a small circle to bring the point of maximum illumination within the focus of the lens. In Park Avenue tunnel, the signals will consist of lights, operated by the track relays, without any moving parts whatever. The lamps themselves will be coloured, and give appropriate signals when lighted. A similar arrangement will be made for the signals in the Grand Central Station, but in this case the circuits for the signal lamps will be completed by the levers for the signals.

The operation of interlocking and the switch and signal movements at points under manual control, are made by direct currents furnished by storage batteries of 55 cells, and having capacities of from 80 to 320 ampere-hours, according to the amount of work to be done, placed in separate battery houses near the signal boxes. These batteries are charged by special A.C. to D.C. motor-generators, fed from the 3,000-volt signal line, and furnishing direct current at 150 volts. The batteries will be charged, on the

average, every fourth day. The release of the lock of the lever is obtained by the motor of the switch or signal movement running as a generator immediately after completing its stroke.

Short track circuits controlling the locks of the switch levers are being substituted for the ordinary detector bars in all except a very few cases. Advantage is taken of the circuits thus provided between the tracks and the signal boxes controlling them, to illuminate corresponding sections of a track plan hung in the signal box, so that the signalman may have complete information of the condition of all parts of the track under his control. The track plan is painted on ground glass, and divided into sections at the back, corresponding to the sections of the track which are to be separately shown. When any section is occupied a red light is shown on that section of the track plan ; when clear, a white light is shown. A similar arrangement is in use on the District Railway in London.

The undertaking is of a most interesting character, and the difficulties of combining the automatic track circuit system of signalling, which has now obtained so strong a hold on American railways, with the use of the track rails for the return currents for electric traction have been met in a characteristically bold manner. Details of the estimated cost of the signalling installation are lacking, so that no comparison with a similar installation of the ordinary character is possible, and information respecting the cost of operation can only be obtained after the installation has been in use for some time. The ultimate success, however, of the system will depend upon the financial and operative results obtained, and there seems to be no reason why these should not be favourable. At first sight the number of transformations seems formidable, and the electrical efficiency, so far as the signalling is concerned, must undoubtedly be low. The consumption of electrical energy for the operation of points and signals is, however, extremely small, and in this case will be an almost infinitesimal part of the consumption for all purposes, and the low efficiency cannot appreciably increase the cost of distribution of the whole supply.

OERLIKON SINGLE-PHASE LOCOMOTIVES.

We have received from Mr. G. Wüthrich, manager of the British Department of the Maschinenfabrik Oerlikon, particulars of some new alternating-current locomotives, constructed at Oerlikon for experimental trial on the Seebach-Wettingen line near Zürich. The principal object was to test a new mechanism for taking current from an overhead conductor, with the secondary object of trying a new general design for alternating-current locomotives. The general appearance of the locomotive is shown in fig. 1. The pressure of the overhead line is 15,000 volts at 15 cycles. This is reduced by transformers in the locomotive to 600 volts, at which pressure, subject to regulation by apparatus in the cab, the current is supplied to the motors. The locomotive is carried on two four-wheel bogies. Each bogie carries a single-phase series motor geared with a reduction of 1 : 3·1 to an intermediate shaft lying between the axles of the wheels, and a little above

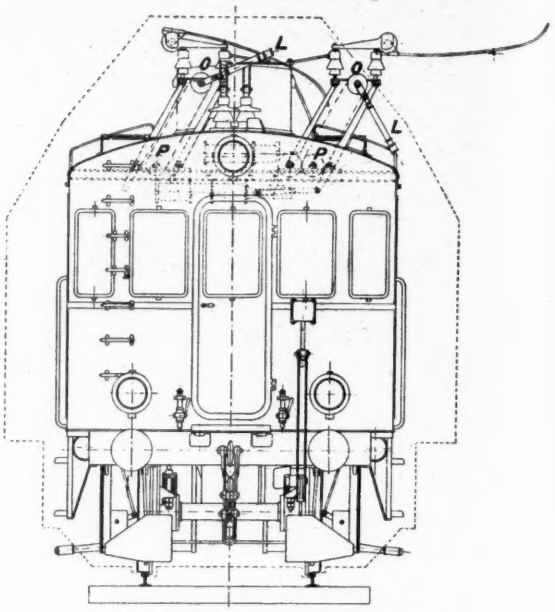


Fig. 2.—Arrangement of Collectors.

them. This intermediate shaft and the four wheels are coupled together so that every wheel is driven. Moreover, the bearing of the crank-pin of the intermediate shaft can move vertically in its seat in the coupling link, so that the wheels can rise and fall vertically while travelling, without communicating shocks to the gears and motors.

The construction of the collecting apparatus, which is the principal novelty in the locomotive, is shown in figs. 1 and 2. The locomotive carries two sets of collector gear on opposite sides of the roof, and fore and aft of one another. The actual collectors are pairs of curved steel tubular rods, with brass rubbers, of a form easy to replace when worn. These rods, provided with springs to give the necessary pressure, swing in planes at right angles to the track, and are mounted on insulators on a hinged system of parallel links, so that they and the axles on which the collectors turn can be moved outwards from or inwards to the centre line of the roof. In fig. 2 the system on the right hand side is pushed as far outwards as it will go, that on the left as far inwards. The movements of the hinged links are controlled by pneumatic cylinders inside and under the roof of the cab, shown in dotted lines. The frames or links L turning on O are used to hold down the collectors over the middle of the roof when not in use,

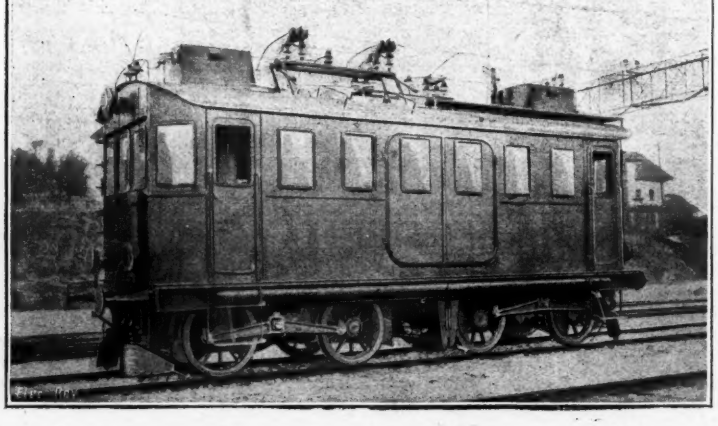


Fig. 1.—Oerlikon Single-phase Locomotive.

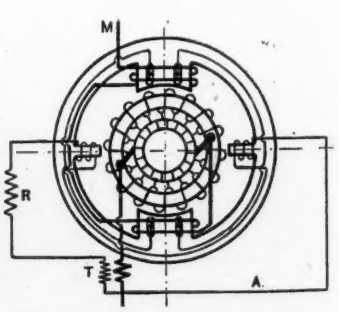


Fig. 3.—Circuits of a.c. Series Motor.

and are manipulated by chain gearing between O and P. The collectors on the right-hand side are resting on the line wire, their controlling link L being dropped clear. The collectors on the left, which are not in use, are shown held down by their controller L. This arrangement allows collection from a line wire in any position over or on either side of the locomotive that is within reach of the collectors. When the line wire is at the side, the collector rubs on the

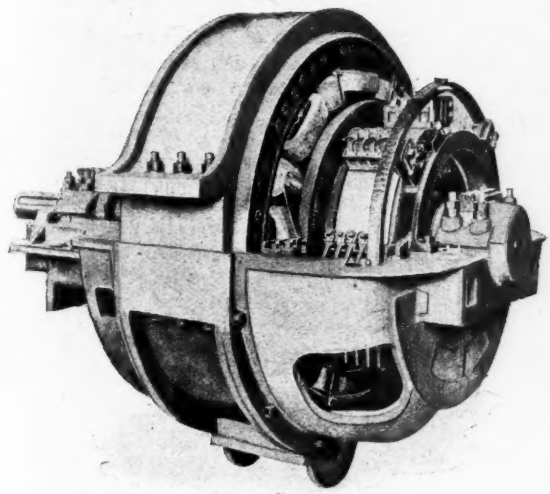
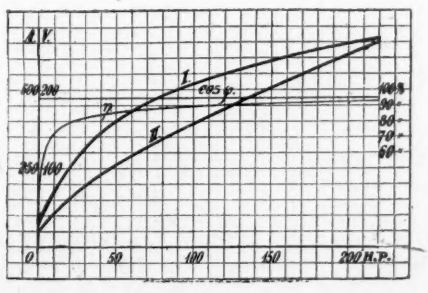


Fig. 4.—200-h.p. Series Motor.

top of the wire. When it is overhead the collector rubs underneath. The collectors on the left-hand side of fig. 2, supposing the link L were released, would be in a suitable position for a line wire placed over the locomotive, and if necessary very close to it. The system is said to have worked in these trial experiments very well and satisfactorily.

The compressed air used for working the collector mechanism and the brakes is obtained from an automatic electrically-driven pump in the cab. The lighting is by 20-volt lamps, whose filaments are so thick that they keep their incandescence sufficiently steadily to be tolerable at the very low periodicity used, 15 cycles. The weight of the locomotive is 43 metric tons, of which 23·5 tons are the



Curve I, Terminal pressure; II, Current strength.

Fig. 5.

weight of the mechanical part. Each motor, weighing 3·4 metric tons, is rated at 200 h.p., at 650 r.p.m. The locomotive can start a train of 200 tons up a gradient of 1 : 12·5, and attain a speed of 28 miles an hour without any sparking at the commutator brushes.

The motor is shown in fig. 4, and consists of a laminated field and an armature of the ordinary d.c. type; the field is provided with projecting main and auxiliary poles, as shown in fig. 4 and the diagram fig. 3, the function of the auxiliary poles being to neutralise the e.m.f. induced in the conductors short-circuited under the brushes by the pulsating main field, and thus to prevent sparking. The exciting circuit A of the auxiliary poles is connected through a non-inductive resistance R to a transformer T in series with the main circuit M, as shown. The main poles are provided with compensating windings in grooves, these windings being either short-circuited on themselves, as shown, or in series with the

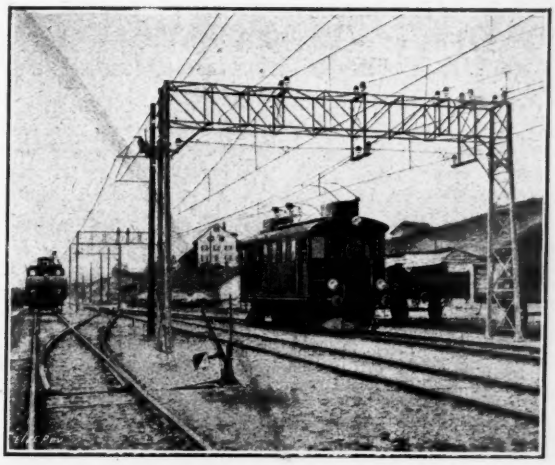


Fig. 6.—Single-phase Locomotive and Overhead Construction.

main circuit. The motor has eight main poles, and runs normally at 650 r.p.m., which is about three times the speed corresponding to synchronism; it operates equally well with a frequency of 25 cycles. The characteristic curves obtained with this motor are given in fig. 5.

The mechanical parts of the locomotive were built by the Swiss Locomotive and Engine Works in Winterthur, while

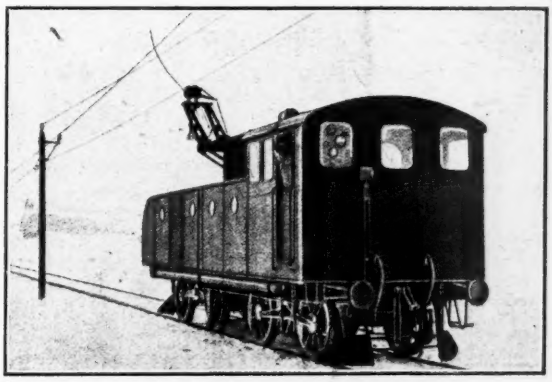


Fig. 7.—Oerlikon-Ward-Leonard Locomotive.

the electrical equipment was designed and made by the Maschinenfabrik Oerlikon. The locomotive is claimed to be the first to be equipped with a single-phase motor of 200 h.p., and has been running nearly a year. Fig. 6 shows the locomotive on the track, with the method of carrying the overhead conductors.

Fig. 8.—Rotor of Motor-Generator.

The Oerlikon Co. has also in operation a single-phase locomotive of the Ward-Leonard type, of which a view is given in fig. 7. The collector is in this case practically the same as in the former, which it really preceded in point of time. The equipment consists of a single-phase motor driving a direct-current generator, which supplies energy to

D.C. traction motors, the D.C. voltage being regulated by hand to control the speed. As is well known, this is a most economical method of control, and gives high efficiency at all speeds, with starting torque limited only by the heating limit of the motors.

These considerations, it is pointed out, justify the use of the Ward-Leonard system in spite of its complication, in cases where severe gradients exist, rendering the recuperation of

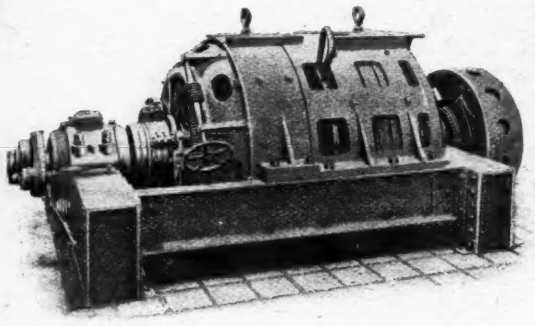


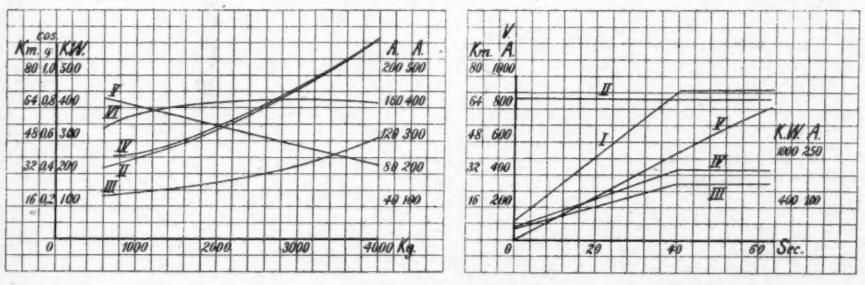
Fig. 9.—Motor-Generator.

energy desirable, or where the utmost economy of energy is called for. Fig. 7 shows a locomotive of 44 metric tons weight, the whole of which is available for adhesion, and developing a tractive effort of 600 to 4,000 kg. at speeds between 70 and 36 km. per hour.

The frequency recommended is 25 cycles per second, at a working line pressure of 6,000 volts, which can be employed in the A.C. motor without a transformer; if a higher voltage (up to 20,000 volts) is employed, a transformer must be used, increasing the total weight to 46·5 tons. The frequency, however, can have any desired value whatever, and in this respect this system is superior to that in which a commutator A.C. motor is used.

The electrical equipment, including the controlling gear, air pump and all accessories, weighs 25·1 metric tons; the two bogie-trucks, frame, cab, &c., weigh 19 tons, making a total of 44·1 tons.

The motor-generator (figs. 8 and 9) consists of an induction motor with short-circuited rotor, a D.C. generator with



Curve I, Terminal pressure of D.C. generator, volts; II, Current from D.C. generator, amperes; III, Current from line (at 6,000 volts), amperes; IV, Power from line, kilowatts; V, Speed in kilometres per hour; VI, Power factor.

Figs. 10 and 11.—Characteristics of the Ward-Leonard-Oerlikon Locomotive.

auxiliary poles, and an exciter, all of which are mounted on a common shaft running at 730 r.p.m. The average load on the shaft is 520 H.P., and the maximum 1,100 H.P. The traction motors are separately excited, for pressures from 0 to 900 volts, and speeds from 0 to 1,200 r.p.m.; each of them has a normal output of 95 H.P. and a maximum of 200 H.P., and drives through gearing with a ratio of 1 : 3·5. The motors (and the transformer, if there is one) are artificially cooled.

The motor-generator is started by using the exciter temporarily as an A.C. series motor, for which purpose it is specially designed. When full speed is attained, the main motor is switched on, and the exciter is connected up as a shunt-wound dynamo, energising the fields of the generator and traction motors. The direction of motion of the locomotive is determined by the connection between the brushes of the motors and those of the generator; the speed is controlled by resistance in series with the generator and D.C. motor fields. Regeneration is effected by exciting the fields of the motors so that their E.M.F. exceeds that of the generator and runs the latter as a motor, and increasing the speed of the motor-generator beyond synchronism.

All these operations are carried out by simple barrel controllers. Fig. 10 shows the characteristics of the combination when running free, the terminal pressure of the generator being kept constant at 900 volts (the most economical condition for normal running), and the speed varied by means of the excitation of the motors.

Fig. 11 shows the process of starting on a level, with a train-load of 170 tons; the operation is divided into two stages, first at constant current and variable voltage; secondly, at constant power.

This locomotive has been in use on the Wettingen-Affoltern section of the Swiss State Railways for two years, and has given satisfactory results, with a working pressure of 15,000 volts, at a frequency of 15 cycles per second.

We understand that the Oerlikon Co. has orders in hand for both of the above-described types of single-phase locomotives.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Woolwich Appointment and Municipal Muddling.

I observe that the letter signed "Once Bitten Twice Shy," which appeared in your issue of 24th ult., has evoked a reply from the Mayor of the Borough, and as another of the "Once Bitten" coterie I also would like to offer some remarks.

It is something to know that the Establishment Committee has felt some regret at being unable to select the required assistant from the six applicants recommended by the Electricity Committee; and I, for one, hope that it has caused no sleepless nights.

The "very careful consideration" given to the recommendations of the chosen six must have been but half-hearted, seeing that only three out of the six called were seen, and the others dismissed. Would it not have been better and more just to have seen the whole six, or rather the whole five, as one of the applicants is already on the borough staff? Admittedly, the vacant post requires to be filled by one fully conversant with the duties appertaining thereto, but how could the committee arrive at the conclusion that out of the six applicants not one was suitable, when only three were interviewed? Again, how is it possible to test the "natural gifts" of a likely candidate without interview? Apparently the members of the committee at Woolwich have unnatural gifts which permit them to examine through the thick stone walls, and fine oak panellings of what is really a most gorgeous town hall, the candidates who wait their pleasure. It must be so, as a further conclusion arrived at was that the salary offered (£200 per annum) was inadequate to tempt the best talent. There are so many posts now open in the electrical trade at £200 per annum, that the seeker of a new post can afford to be particular.

The remark that only one applicant could have the post is worthy of a Daniel, and I think the fact must have been overlooked by every one of the applicants.

As to the taking up of references, it is news to me that in applying for a post it is necessary to state that information

as to present employment is only given in confidence. I have always understood that to take up a reference is the very last step before making an appointment. Had I known that it was necessary to state this in my application, it would probably not have caused me to have recourse to the use of the title of Æsop's fable—

The Dog and the Bone.

As an applicant for the above and a commercial assistant of many years' experience in the electrical profession, will you kindly allow me to say, in justice to myself, that the explanation why no appointment was made, as stated by Mr. Gilbert Slater, the Mayor of Woolwich, in his letter of September 5th, cannot possibly be correct.

Mr. Gilbert Slater must know perfectly well—though he does not mention it—that, of the six candidates who were requested to *meet* the Establishment Committee, three of the number, including myself, although in attendance, were *not* interviewed by those gentlemen.

His statement, therefore, that, after very careful consideration, none of the *six* candidates were found suitable for the post, does not represent the true facts of the case; further, to brand as incompetent men whom they had never seen, is monstrous, and little short of a libel, and moreover, is calculated to seriously imperil the future prospects of the men in question.

If Mr. Gilbert Slater possesses a single atom of an Englishman's love of justice and fair play, he will withdraw his statement at the earliest possible moment, and apologise for having published it.

Commercial Assistant.

September 10*th*, 1906.

I have seen the reply which the Mayor of Woolwich sends to my letter, and I am glad to notice that we are in agreement as to most of the facts. The Mayor, however, omits to refer to, or to express any regret for, the manner in which the candidates were kept waiting about—surely a bad example for those from whom business qualifications were expected. He also states that present employers were not written to "in any case in which the candidate indicated that he desired that his candidature should be treated as confidential." For the Mayor's edification I should like to state that it is the usual practice in business circles *in every case* to treat an application for a position as confidential and only to refer to present employers when the candidate is about to be engaged and with his consent. But then, the general complaint is that the municipalities and business know not each other. As it is, it may interest the Mayor to learn that one of my colleagues who kicked his heels with the rest outside one municipal sanctum, has, in consequence of the Establishment Committee's action, lost his post with his present employers.

Once Bitten, Twice Shy.

Free Wiring by U.D.C.'s.

Could you assist me, either by information that you may at present possess, or through your "Correspondence" columns, in placing myself in communication with resident engineers of Urban District Councils, not Corporations, who are at present carrying out lamp renewal schemes for consumers, and, better still, if they are also working assisted wiring schemes, also hiring out of motors, arc lamps, &c.?

This is an undertaking that would be greatly assisted by any of the above schemes, and my Committee are agreeable, but the Clerk states that there is no account recognised by the L.G.B. auditor that the expenses of the above can be placed to.

L. H. King.

Whitby, *September* 8*th*, 1906.

Long Hours in Government Dockyards.

I have just seen particulars of the appointment open for station supervisors (shift engineers) at H.M. Dockyard, Portsmouth.

The candidates are informed that they will have to work seven shifts of eight hours each per week all the year round (unless they like to get leave without pay).

As all *respectable* stations give their staff at least one shift off a week and 14 days' holiday in the year on full pay, I think that the Government can at least afford to treat their shift engineers as well as other employers, especially as the hours of the workmen employed in the dockyards are so short.

I hope you will call Mr. Wordingham's attention to this, so that he will at least see that his assistant at Portsmouth treats shift engineers as human beings. How can anybody expect a shift engineer to be bright and ready for emergencies if he works 365 days in the year, and extra when breakdowns occur!

Not Having Any.

The Penetrating Properties of the Arc Light.

Mr. Bastian is his letter of August 27th on this subject makes certain statements which are quite in opposition to the accepted theories on the same. The red colour at sunset is not due to refraction, and cannot be so, as a little consideration will show. The blue light after sunset certainly is due to refraction, but the red rays from the same refraction never reach the earth, and are only seen in the copper colour of the moon during eclipse.

When the sky appears violet-blue to us during the day, the complementary red rays are giving people away to our east a red sunset. The reason for this is that the tiny particles of suspended solid matter in the atmosphere reflect the short violet and blue waves but are too small to reflect the longer red ones. In like manner a pebble will reflect a ripple but not a wave. A pretty illustration of this action is seen on sending a strong beam of white light through a clear liquid in which precipitation is beginning to take place. An observer at right angles to the beam will see at first no light, then a pale violet, gradually changing to blue as the solid particles coalesce and increase in size. The final colour, of course, is that which the precipitate has in bulk. Similarly the sea, smoke, fog, &c., appear blue, as also do the first tiny water particles of an escaping steam jet, which get whiter as they increase in size. The blue colour of distant objects is due to the same cause, and Mr. Bastian will perceive the correctness of this when he recollects that it is distant dark objects rather than white which appear blue. Any photographer will tell him it is not a question of absorption, since distant hills always appear far too light on account of the blue rays from the intervening atmosphere.

From the above it is clear that a yellow or red source of light will penetrate fog better than a blue source.

Sol.

York, *September* 10*th*, 1906.

Railway Engineers and Electricity.

Without entering into matters controversial, would it not be as well for your correspondent to remember that the discussion on the paper by Mr. T. Hurry Riches and Mr. S. B. Haslam stands adjourned until the next meeting of the Institution of Mechanical Engineers in London.

At the Cardiff meeting the time given for the discussion of papers was extremely limited, and, as your apparently nameless and homeless correspondent must be aware—he says he was present at the meetings—the paper referred to aroused such a keen interest that it was unanimously decided to adjourn the discussion. Wherefore—say out of respect to the sister institution, from which so many of us have sprung—let us wait and hear what we shall hear.

Theodore Schontheil.

Cardiff, *September* 10*th*, 1906.

Rail Corrugations.

Upon the principle that one original idea, however absurd, is worth a dozen old ones, however wise, I beg to submit another theory as to the cause of "roaring rails." Most of your readers will be conversant with the process by which the "milled" or "knurled" edges are formed upon ter-

minal nuts, &c., and probably, like myself, they have often marvelled at the ease and rapidity with which the revolving milling disk does its work.

Now, I believe that it is an accepted fact that all materials possess some degree of elasticity; and if this is the case, I think it can be shown that the tire of a *spoked* car wheel must, to some extent, have a similar effect upon the permanent-way, as the milling tool has upon the edges of the blank terminal screw.

When a moving car-wheel has one of its spokes perpendicular to the rail, it must press upon the latter with greater force than when the point of contact between the tire and rail is midway between two spokes.

The progress of the wheel would, in such circumstances, be a succession of varying degrees of pressure. Of course, the variations would be almost infinitesimal, but I am, nevertheless, inclined to think that what between the normal weight of the loaded car, and the enormous pressures exerted by the wheel upon the rails during the periods of braking and acceleration, the milling effect would, in time, become appreciable. Once the slightest unevenness was produced, each succeeding wheel would have a tendency to accommodate its points of unequal pressure with the corresponding parts of the rail in the same way as a blank nut will adapt itself to the corrugations of the milling tool, notwithstanding any differences in circumference.

The milling effect would, of course, be immensely greater in the case of a driving, than of a rolling, wheel; and this is probably the reason why the "roaring rail" does not trouble the horse tramway companies. A driving wheel tends to dig itself into the rails, and because the mechanical power is transmitted from the axle to the tire through the spokes, the digging effect is more pronounced opposite the junctures of the spokes with the tire than elsewhere. Unless the distance between the respective points of contact of the front and rear wheel with the rail represents a complete number of the distances between two spokes, each wheel might possibly start a wave system of its own; and in such a case the wave-lengths of the corrugations on the rails would not correspond to the distance between two spokes.

If the above theory is correct, the cure of the "roaring rail" is simplicity itself. Use spokeless or wood-blocked wheels.

I shall be glad to hear what your readers have to say.

I admit that the theory is incomplete, inasmuch as it does not explain some of the peculiar phenomena observed on the Indian Railways; but it is, of course, possible that the trouble with the latter does not spring from the same cause as that which is playing such havoc with tramrails.

D. Evans.

Cardiff, *September 8th*, 1906.

EVERSHED'S PATENT BRIDGE-MEGGER.

We recently paid a visit to the Acton Lane Works, Chiswick, of Messrs. Evershed & Vignoles, Ltd.—a restless, uneasy firm, like the Athenians, always running after some new thing, and trying to beat themselves—to inspect their latest innovation. This took the form of an addendum to their "Megger" whereby the combination extends its range downwards from the previous minimum reading of 5,000 ohms to a fraction of 1 ohm, thus filling in a part of the scale formerly blank.

The mode in which this improvement is effected may be gathered from the accompanying figures and explanation.

The Megger itself is modified externally only by the addition of four insulated terminals, a ratio switch, and a change-over switch. Internally the modifications are more extensive, as the connections are radically altered by the change-over switch; but this does not affect the working of the Megger as such in the least; the simple operation of turning the switch to "Megger" completely and instantly restores it to its ordinary function of measuring insulation resistances from 5,000 to 40 million ohms by direct reading. A full description of the Megger was given in our issue of December 9th, 1904, page 937, and fig. 1 shows its appearance as modified.

Turning the change-over switch to "Bridge," the ohmmeter of the Megger becomes a galvanometer, and the two windings of the

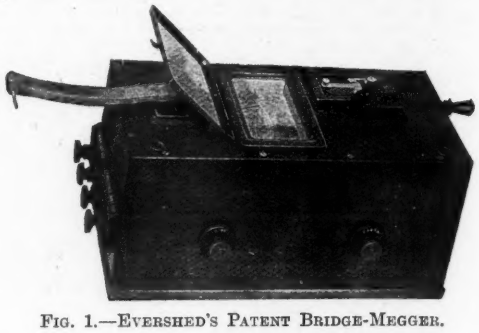


Fig. 1.—Evershed's Patent Bridge-Megger.

generator are put in parallel, so as to secure a larger current-carrying capacity at a lower voltage. The ratio arms of the bridge, which are enclosed in the Megger, are at the same time brought into circuit. The resistance box is next connected to the appropriate terminals by flexible leads, and the resistance under test to the remaining pair. The Wheatstone Bridge is then complete. The whole of the connections, internal and external, are shown in fig. 2.

The resistance box is illustrated in fig. 3, and is of the direct-reading dial type. It contains four sets of coils, from 1 to 9,999 ohms, each set being controlled by a multiple-contact rotary switch carrying a figure dial, which shows the number of units, tens, &c., in circuit, at a little window in the top plate. The complete

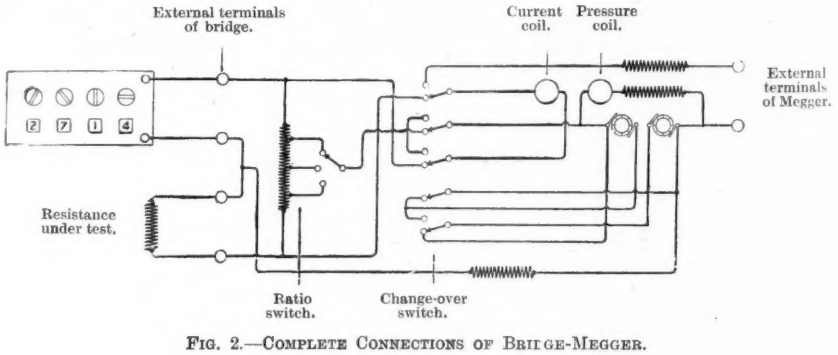


Fig. 2.—Complete Connections of Bridge-Megger.

The Change-over Switch is shown set to "Bridge."

range of each switch is included within half a revolution, and a mechanical device ensures precision in the setting of the switch for each contact. The figures being in their correct order and position, it is easy to read off the resistance and difficult to make a mistake.

Fig. 3.—Direct-Reading Resistance Box.

Particular care has been taken in the design of the resistance switches; many experiments have been made to ensure the maintenance of a good low-resistance contact, and the whole of the parts are entirely enclosed in a dust-proof case. Diagrams of

connections and instructions for testing are pasted into the lid of the resistance box, and provision is made for neatly stowing the leads in the box when they are not in use.

It will be observed that the following advantages are secured:—There are no plugs to insert or lose, no keys to tap, no scattered figures to add up and no levelling to do. To take a reading, the handle of the generator (which takes the place of a battery) is turned, and the resistance is varied until the pointer of the ohmmeter is brought to the point marked "Infinity." This operation is facilitated by the instructions "Increase R," "Decrease R," which are permanently inscribed on the scale, the direction of the deflection being always the same under given conditions of departure from balance.

The range of resistances which can be measured with the Wheatstone Bridge thus formed extends from one million ohms to one-hundredth of an ohm; in each case a result is obtained

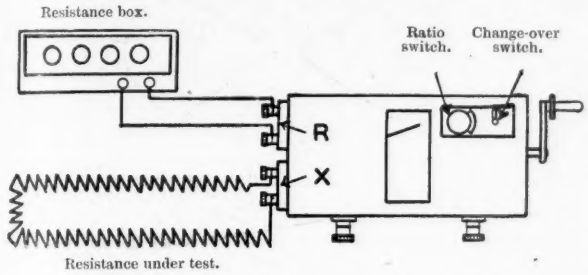


Fig. 4.—Connections for Measuring Resistances up to 10,000 ohms.

accurate to four figures, which, of course, is amply sufficient for practically all the measurements that the workaday engineer is called upon to make. The pointer is always steady, and a change of one unit in 10,000 is distinctly observable upon the scale. The rate of turning the handle does not affect the reading, unless the unknown resistance is highly inductive, such as a dynamo-field coil, or has a high capacity; in such event, the speed of turning the handle must be above the value at which the constant-speed device comes into play. When commencing a test, however, and until approximate balance is attained, the handle is turned slowly. The whole process of balancing can be carried out in a remarkably short space of time; but the coils are so constructed that they can be left in circuit for a long period without being overheated.

Fig. 4 shows the connections of the apparatus for measuring resistances from ·01 to 9,999 ohms, the ratio switch being turned to

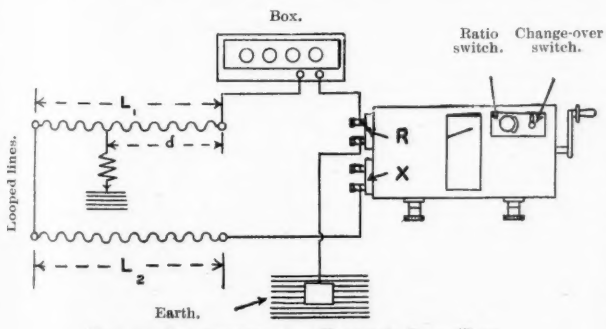


Fig. 5.—Connections for Varley's Loop Test.

100, 10, or 1 as required. For higher resistances the box and the resistance are interchanged, and the ratio switch used on 10 or 100; in this case the words "Increase R" and "Decrease R" must be read in the converse sense. Resistances above 10,000 ohms can also be measured with the Megger alone, but, of course, the bridge test is the more accurate.

Obviously, the Bridge-Megger can be used for localising faults on lines, provided that the latter are of sufficiently high resistance per unit of length—as, for example, telephone or telegraph lines. Fig. 5 shows the connections for Varley's loop test, the distance of the fault in ohms, d, being $\frac{1}{2}(L_1 + L_2 - R)$, where $L_1 + L_2$ equals the whole resistance of the loop, measured by the bridge method, and R is the reading obtained at balance with the connections as shown and the ratio unity.

The handiness of the bridge, and the quality of the workmanship, are fully up to the high standard set themselves by Messrs. Evershed and Vignoles, to whose admirable spirit of progress and determination not to let well alone, but rather always to go one better, we have already referred.

Brandon Lighting.—The U.D.C. has refused the application of the County of Durham Electric Light Co. for permission to use overhead mains.

ORGANISING THE SALE OF ELECTRICITY.

Organisation and Conduct of a New Business Department suitable for Central Stations in Cities of 50,000 Population and Under.

By M. S. SEELMAN, Jun.*

I have been recently in a number of cities, not alone of 50,000 and under, but of 100,000 and over, where the central station had not only no organisation for securing new and retaining old business, but no sense or appreciation of the lack of it. These companies do no advertising, make no attempt to educate their public to a knowledge of the superior advantages of an electrical service, have no special propositions, employ no canvassers. Some of them do not even follow up the permits for new buildings. They give no suggestion to the customer as to the most economical and effective methods of lighting his home or store or factory—that is left to the wiring contractor, who in all likelihood has an exceedingly primitive and limited idea of illuminative engineering. The attitude of such a central station may be thus expressed: "Here we are. If you really want to buy current from us and are careful in arranging necessary preliminaries and formalities, we will agree to supply it to you." In one city of about 50,000 inhabitants, not 100 miles from New York, the customer, before being permitted to do business with the central station, must come to the company's office and sign his (or her) name in a big book kept for that purpose.

The business that comes to these central stations drifts in. If the station makes money it is rather in spite of itself than because of itself. And, under the circumstances, sooner or later the municipal ownership propaganda is certain to take strong hold. There is need of stirring and enlightenment. These stations must "awake, gird up their loins and go forth to do battle" for business.

If I were to be asked what the company, awaking from its lethargy and desirous of securing the possible business within its sphere of operation, should first do towards establishing an effective organisation, I would say:

Hire a good man; if possible, one familiar with the kind of work he will be called upon to do; a man under 40, if you can; better yet, under 35. If you can secure one with a combination of technical and commercial knowledge, not necessarily an engineer, but a man who has been trained around a central station, knows something about generating and distributing methods and has tackled lighting and power problems before, so much the better. He will have the less to learn and you the less to teach. But, above all, he must have "ginger," he must be a hustler with red blood in his veins, and in his heart the zest for labour and the pride and loyalty of the service. If the time comes when expert or technical knowledge which he lacks is needed, you can buy that for him, but you cannot buy the energy, the dash and the vim if it is not there.

There are many such men to be had. Sometimes we find the very man in charge of some smaller central station. A good place to look for him also is among the employés of the larger companies, where the live young man is likely to have had a more comprehensive experience than would have been possible in a smaller station, and still, because of peculiar conditions, to be working for a wage which would make an offer well within your limit personally flattering and financially attractive.

This man should have charge of the organising and conducting of our new department. Let us consider him as having been installed and call him the general agent.

The first step our general agent shall take is to establish a first-class and highly attractive office and showroom. This should be located on the main street or principal "square" of the town. If the company's offices are already so located he can alter and utilise them—or a portion of them—for the purpose. But if, as is too often the case, the offices are on some side street at a distance from the business centre, or even—as frequently happens—in the generating station itself somewhere on the outskirts of the city, then the general agent must either get the company to move its entire offices, bag and baggage, to a main location, or else hire for his department alone a suitable store. I should recommend the former course, so that every time a customer comes in to pay his bill, or anybody enters the office for any purpose, he must necessarily see the exhibit of electrical appliances and utensils. Thus the law of suggestion comes into play, and the visitor becomes more or less interested in those things to which we desire to attract his attention.

This new office and showroom must be made bright and attractive. The colour scheme should be a creamy white, that will reflect the light to the best advantage. The electrical exhibits ought to be as varied and complete as possible. A great many exhibits can be secured at little cost from manufacturers, who will be glad to co-operate with the central station for the advantageous display of their wares.

The windows of this office must be utilised to illustrate different methods of show-window lighting. Arranged on separate switches can be shown exhibits of trough incandescent lighting (as by Frink reflectors), incandescents in combination with cone or holophane reflectors, and Nernst lamps with the special Nernst reflectors.

* Winner of the $500 prize given by the Co-operative Electrical Development Association, Cleveland, Ohio. Reprinted from New York *Electrical Review*.

The common method of window lighting by means of projecting incandescents running around the sides of the windows, or by chandeliers, may also be shown; but in this case care must be taken to explain to customers that wherever the object of the lighting is to display the goods, then one of the three first-mentioned systems of reflected light from hidden sources is the more desirable, while the visible lamps, projecting or in chandeliers, may only be used to advantage when the object is not so much to draw attention to the goods as to attract the eye to the window itself, as with a saloon.

In the show window itself should be placed an exhibit of electric fans and heating appliances—such as irons, water and food heaters, coffee percolators, chafing dishes, stoves, toasters and grids, heating pads, curling irons and the like. Adjacent to each appliance place a neatly printed or painted card, naming the article and a definite price for its use, thus:—

THIS ELECTRIC IRON Can be used for one hour FOR SIX CENTS.

If there is room in the window, a sewing machine operated by a motor should be prominently featured and kept running, as a moving object attracts more attention than a still-life exhibit. If you prefer, a buzz saw or a coffee mill might be thus utilised instead of the sewing machine. Two or three handsome reading lamps will add a touch of art and colour to the window.

An exhibit of various types of lamps should be installed in the office. These should include arc lamps (one showing the concentric diffuser), one, two and three-glower Nernst lamps (there is a simple but highly artistic five-single-glower Nernst lamp fixture which could well be made a part of this exhibit), Meridian and high-efficiency lamps, Cooper-Hewitt tubes, turn-down lamps—such as the Hylo—and attractive and efficient clusters, such as the "Arc-Burst" and the "Pagoda" reflecting arc. Holophane glassware could be shown as an annexe to this exhibit.

Two or three types of panel signs, individual letter signs and transparencies should be installed in this showroom if there is space for them; novelties in signs and transparencies could be added from time to time.

The balance of the exhibit should be made as complete and interesting as is possible within a reasonable expense limit. There must be a motor exhibit, of course, and among other appliances that could be given a place in the showroom might be mentioned these:—

Electric pump, electric organ-blower, electric forge, electric drills and lathes, electric coffee mill, combination electric meat chopper and coffee mill, electric dough mixture, electric ice-cream freezer, electric vibrators, electric dental machinery, prepayment meters, theatre dimmers, electric vacuum carpet cleaner, motor operating refrigerating machine, motor operating adding machine, the Gray telautograph.

In a prominent place over the desks which his canvassers are to occupy our general agent should have a sign hung, reading:—

DON'T TALK VOLTS & AMPERES. TALK DOLLARS and CENTS.

And this brings us to the subject of canvassers. The general agent will, of course, take steps at once towards securing the aides required in his campaign for new business, the principal questions that arise being—how many does he need? in what manner shall he secure them, and how much ought he to pay them?

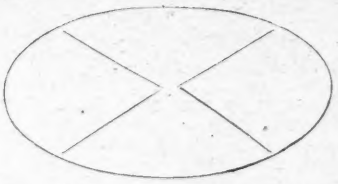
The solution of the first question must be governed to a considerable extent by local conditions—the industrial, commercial and residential nature and status of the town. Roughly speaking, I should say that, other things being equal, a city with a population of 50,000 or less, which is alive and fairly prosperous, would require one canvasser to about every 12,500 population. This is an elastic rule, however, and must be freely interpreted. For instance, I have in mind a factory town in New England, with a population of 100,000, of which 35,000 are mill hands, comparatively few of which would be "prospects." In deciding upon the number of canvassers needed there, that 35,000 would receive but scant consideration. Take it, then, that we start with one canvasser for every 12,500 population, and these we can lop off or add to as future conditions and contingencies may show to be necessary.

To secure the men we want, we must either again draft from the larger companies or advertise in technical publications. Very likely our general agent knows one or two men of the type he wants who are working for other companies, and whose services he can secure. It may be possible to take an employé from some other department of the business and put him to canvassing, but my experience has been that such men are rarely effective and usually unsatisfactory. As a rule, if I had to, I would rather take salesmen from some other line of business and educate them.

As to remuneration, whether straight salary or salary and commission is the best method of paying, is a debatable question. I am a firm believer in the latter method as the one most effective for securing new business. Especially is this true in residence districts, where the householder must frequently be interviewed at night, the only time he is to be found at home. The canvasser on straight salary naturally hesitates to give up many of his evenings to this work, but if each call may mean a dollar or two to him, it becomes a different proposition. An equitable arrangement for the payment of canvassers would be, I should say, about $12 per week salary and a commission of two cents per 16-c.p. lamp equivalent for all over 250 equivalents a month the canvasser turns in. In addition the company should pay his car fares and incidentals.

Now then, let us suppose we have gathered our selling force together and have equipped our showroom. We are still not quite ready for business. It is advantageous, I believe, to give the new men the run of the office for a day or two, so that they may become acquainted with the company's physical lay-out and its installation, metering and service methods. During this time our general agent can have divided the city into districts, one for each of his canvassers. A word about this work of districting.

There are many cities where the business district is largely concentrated in the centre of the town. In places of this kind I believe it an excellent plan—at least to start with—to district along lines starting at a common centre in the business section and radiating outward, thus:—



In this way you give each man a portion of business section, of residence locality, and probably of power territory. Later on you may find that one of your men is especially effective in residence work, another for business or for power propositions, and it is then easy to redistrict in accordance with the special qualifications of your men. Or, again, later on—to vary the system—occasionally one man may be given one line of business—the printers or the butchers or bakers, or whatever line may be selected—to canvass right straight through, giving a report upon each one interviewed.

Now then, we are pretty nearly ready to canvass. Our general agent gives his men a selling talk—not only to inspire them with enthusiasm, but to give them the last word of information as to how to approach and handle various light and power propositions as they may present themselves, so that the men may be competent to advise prospective customers as to matters involved in their installation, such as wiring, selection of lamps and glassware, location of switches and outlets, painting and decorating of houses and stores to produce the best and most economical lighting effects, types of motors in general most suited for special classes of power work, ideas and methods of apportioning the units in a power installation, &c. It is well if these instructions, together with the special propositions offered by the company, be gotten up compactly in small book or pamphlet form and handed to each canvasser. Of course the canvasser must be told to refer at once all propositions that he finds himself unable to adequately or competently handle, to the general agent. If he starts such business he is entitled to his commission thereupon, even if the deal has to be consummated by the general agent or some expert or specialist. In connection with this talk of the general agent to his men, it may be said in passing that it is excellent business to secure from time to time and as frequently as possible experts in various lines to address the members of your business department - illuminating engineers, power men, Nernst, Meridian and high-efficiency representatives, heating appliance manufacturers and the like. This helps a great deal.

Now to canvass. Some might advise a preliminary canvass to secure names and addresses of prospects, but I believe in digging right in from the start, reaching out after business from the first day. The district agent begins work about 9 a.m. and is instructed to report back about 4.30 or 5 p.m. If this is not practicable on account of distances, then reports can be limited to the morning session, the district agent arriving at the office at eight instead of nine o'clock; but where practicable it is better to have the agent return late in the afternoon so that he may report on his day's business then, giving time for the general agent to go over the reports and prepare his instructions to his men for issue in the morning.

There are a number of systems of keeping track and record of canvassers' work. The card system is probably the best for the city of 50,000 or less. The district agent's daily report of his work he makes out in the form of a card for every one visited, on which card is inscribed name, address, nature of business, date visited, attitude of the visitee, prospects of doing business with him, when to call again, &c. This is not a particularly arduous job for the canvasser, as he is not likely to call upon more than from 12 to 20 people a day.

The general agent must look these daily card reports over carefully before they are alphabetically filed away. He must especially note any difficulties or obstacles encountered by his men, and he himself must bend his best sales efforts on these especially difficult problems and propositions. If a canvasser reports a man as positively out of the prospective class, before the general agent accepts this classification, he should either send someone else to see the recalcitrant or go himself. In this way the impossibles can be eliminated and the card catalogue list becomes a list of prospectives.

And this list of "prospects" soon assumes proportions and furnishes the best possible list for the effective distribution of printed matter.

And this brings us to the important subject of advertising.

I am inclined to believe that newspaper advertising is likely to be more advantageous and profitable in a small city than it is in a big one. There should be more or less of it done in every city, not only because it promotes a desirable feeling of goodwill between

the newspapers and the corporation, but because it certainly has a very real educative value. In the average big city, however, the character of the population is such that, out of a circulation of, say, 100,000 that some newspaper may have, only one or two thousand may be possible customers. In advertising, the company must pay to reach the 98,000 unprofitable ones along with the 2,000 prospects, and it is, as a general proposition, uneconomical to pay for all this surplus publicity. In the average small city conditions are different. Circulations are not so large nor mediums so numerous, advertising charges are not so heavy, and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less, I would utilise the newspapers to a considerable extent. Take a whole page or half-page once in a while on some special occasion, such, fo instance, as a reduction in rates or the inauguration of some new policy or special proposition, or a marked addition to station capacity. At other times use an advertisement each week in weekly papers, and about three times a week in dailies, not all the year round, but for certain months in the year, pausing now and then to take breath and gather renewed energy for a new campaign. The size of these advertisements should not be fixed hard and fast, but should vary up from a minimum of 5 in. single column or 4 in. double, according to the particular message it is desired to convey.

I doubt if a central station in a city of 50,000 or less would support a first-class advertising man, and the other kind is of little use—liable to cost a good deal more than his salary. If your general agent can write a good advertisement—and a good advertisement does not need to be "smart" at all; it is merely the embodiment of a common-sense argument or a special proposition in an attractive form—so much the better. He can do that part of the work to advantage, especially if it is some special proposition or announcement of local interest and value that is being made. For general advertising of educative effect some of the advertising agencies that have made a speciality of electrical work—notably the Curtis Advertising Co., of Detroit, and the C. W. Lee Co., of Newark—get up clever and attractive newspaper advertisements, both text and illustration, and supply them at a price that any central office can afford. Or the general agent can secure samples of the advertisements of the larger companies by writing for them, and many of these can be readily adapted for local use.

The same rule or methods may follow in securing advertising matter for the other and, in my judgment, more valuable system of advertising by letters, circulars, booklets, &c., distributed through the mail. The advertising agencies get up some very excellent and relatively inexpensive general educative matter which is printed with your name and—as far as any one who receives it knows—emanates originally from you. In this category is the "residence number" of the electrical bulletin recently issued by the Curtis Co. Letters, circulars, &c., that refer to purely local offers, conditions and announcements must, of course, be gotten up in the home office by the general agent or an assistant, and here again samples of the big companies' advertisements will be of aid, if not to pattern after, at least to suggest ideas and methods of treatment. Another big help is to get a good printer, even if he costs you more. Don't have a poor printer if you can avoid it, at any price. The good one is often able to aid you with ideas, suggestions and plans for the effective construction of advertising matter.

Here is a point that should be borne in mind: Never send out a piece of advertising matter without enclosing a return postcard. A fundamental law of political economy is that man is a lazy animal, and you want to make the path to your front door as easy and smooth as possible. Each different branch of the business should have its distinctive return postcard, so if you send out a lighting circular you enclose a lighting postcard; a sign circular, a sign postcard, and the same with power, fans, heating and refrigeration, if you go that far. Don't make it a postal card; that is expensive; but an attractively printed postcard, with your address and place for 1 cent stamp on one side, and on the other a printed form referring to the matter in hand and space for the name and address of the sender. I have experimented as to the relative advertising value of the penny United States postal card and the plain postcard for this return work, and find that while the cost is as six to one, the latter is nearly as effective as the former. This return postcard method gives you a fair chance to estimate the interest your advertising is arousing, and leads, if the advertising is right and other things being equal, to a continuous and often surprisingly large amount of new business.

The system of doing the bulk of your advertising by mail distribution of circulars, booklets, &c., rather than through the newspapers is the best, because you reach, if your campaign is rightly conducted, just the people you wish to reach, and with the least waste of expensive publicity. Your list of prospects is a good list to work on, and that can be supplemented by special lists for special purposes—as, for instance, a sign list composed of present store customers and stores not yet using the service, but whom you hope some day to secure. Your sign proposition may be the entering wedge. And this brings us now to another very important feature of and factor in a new business campaign, and that is the special propositions.

And right here I want to say that if you want to get a big share of new business, you have got to be liberal, you have got to go half way to meet the customer, you have got to be willing to spend a dollar to make two.

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment, not to mention a profit; yet they turn away haughtily from the proposition to supply a customer with some equipment which in a far shorter period pays for itself and gives a handsome return on the money invested.

There's the free sign proposition for instance; it has proven "good business" everywhere it has been tried, so far as I know. A panel sign costs you complete about $45; with overhead construction customary in the city of 50,000 or less, to hang and connect the sign ought not to cost more that $25. Here's an investment of $70. Take 200 per cent. of your investment—$140—divide it in 24 parts and offer your customers free signs on a two years' guarantee of $6 a month. You are sure to get back the cost of the sign and installation well within the two years, even if the customer's current bills do not run above the guarantee (which is unlikely). As a matter of fact, you usually get back the actual cost, including the proportion of operating expense, within the first year and all the rest above percentage of operating work is "velvet," especially as in fully 95 per cent. of cases the customer keeps on using the sign far beyond the two years of his contract. Not only this, but each sign you thus erect is a good advertisement for you and helps bring another, besides being, as aforesaid, in many cases an opening wedge for other business with the customer, and you retain title to the sign; so that in case of the worst your loss must be small, as the sign with slight changes can usually be utilised for some other customer.

With individual letter signs the return of the investment with profit is even more rapid than with the panel sign because they use more current in proportion to their cost to you. When giving an expensive sign, however, care must be exercised as to the financial responsibility of the recipient.

Still another advantage of the electric sign proposition is that it leads the merchant to realise the advertising value of electric light, so that he not only burns his sign at night, but is likely to get in the habit of keeping his windows illuminated some hours after closing, and this again leads others to do the same. Such night lighting has a far-reaching effect in creating new business for the entire town, increasing the activity and energy of its life, and materially assisting in its development.

The sign is a good advertisement to the customer, too, and economical as well. Suppose it costs him $10 a month for lighting it. How much newspaper advertising could he buy for that amount? How many circulars can he print and distribute? Why, it would cost him that much to buy a thousand postal cards without the charge for printing and addressing them, while his sign, for $10, is brightly visible for three or four hours every night to every one who passes the store, giving it a distinctive character, and "burning his name into the public mind."

The town in which this free sign proposition will not "take," if it is properly advertised and pushed by the new business organisation, must be dead indeed.

Then there are the special lamp propositions. There are doubtless many stores in the city in which we are hustling for new business that are illuminated by the gas arcs or Welsbachs, which we find it impossible to touch with the ordinary standard incandescent lamp proposition. Here is where the Nernst lamp comes in, also the high-efficiency and Meridian lamps. Each has its place. The Nernst is an attractive proposition to a customer, especially a lamp about three-glower size. It is highly attractive, even decorative, in appearance, gives a beautiful pearly white light, and is in every way far superior to any gas lamp, being, at the same time, so efficient in wattage as to permit of free competition with gas; and from the station's standpoint it is not nearly so expensive of maintenance as, from some reports, we might be led to believe. If our friends who are out after new business will supply these lamps free with free glower renewals, even with free wiring and installation for outside lamps, they will find this proposition a potent factor in securing new and profitable customers, and the stores where you install the lamps outside will most likely soon install them inside at their own expense. The Meridian and high-efficiency lamps can also be worked in the same way, either in direct-current districts or on overhead circuits, where the customer, having his choice, may select one of these types as preferable. The new decorative and highly efficient "arc" clusters that have recently been placed upon the market may be utilised to advantage where the customer is disposed to complain of the arc lamp at arc lamp cost of operation. They give adequate illumination of fine quality at a very low cost. With these, as with signs and other lamps, don't be afraid to go half-way to meet your customer.

A method of getting one class of new business which has worked well in at least one large city, but which might or might not be applicable to the city of 50,000 or less, can be utilised with the drug stores.

Here hours of burning are long, and the average drug store may not be able to afford the average rate for the average installation. Still you cannot cut rates for him and be consistent. Get up an attractive advertising bulletin stand of wood and iron that will cost you about $15, with a frame in the top portion for a placard and beneath this pockets for bulletins and other advertising matter. Then make an arrangement with the druggist now using gas that in consideration of his permitting you to keep your advertising stand in a prominent place in his store you will pay him a sum, which subtracted from the bills at regular rates for lighting his store by electricity will make such illumination economical for him. The placards, bulletins, circulars, &c., are changed once a month. It is good advertising for the central station, too, because, as a rule, the right kind of people deal in drug stores, and while awaiting the compounding of prescriptions have time to read your advertising, which is placed where they cannot help but see it.

One way to get at a gas-illuminated store is to offer to draw, gratis, plans for the electric illumination of the store which will provide a lighting far superior to gas, adding materially to the attractiveness of the establishment at a price little, if any, heavier than the storekeeper has been paying for an inferior illuminant. This can be done by selecting the right kind of lamps and glass-

ware and arranging them to advantage. One of your canvassers could easily be educated to do this class of work. Once the plans are drawn, the storekeeper is very apt to become sufficiently interested to wire up and sign a contract.

Now as to residences and new buildings. In the average town of 50,000 there will be found about six architects, in the town of 25,000, three. One of the first acts our new general agent must do is to set himself to get acquainted with these architects, not alone in a business way, but, if possible, socially, so that a feeling of friendliness may spring up between them. Let him join their clubs, take them out to dinner, &c. After this "entente cordiale" has been established, our general agent is in a position to know from the start what is taking place in the line of erecting new structures, and he is less likely to be called upon to continually fight the installation of isolated plants. Get the architects on your side.

Then, of course, the building permits must be followed up closely. Let no guilty man escape. Every new building must be wired, and the way to do this is to see the builder the day his permit is issued (before, if possible), and to follow him right up until the business is done. The same with permits for alterations. When the owner is about to make alterations in his home or store, that is the psychological moment to approach him about installing an electric illumination on the premises. These are new business pointers that can not be neglected.

A far stiffer proposition than the new residence is the unwired old one, and yet there are doubtless hundreds of these—even in a city of 50,000—which, if wired, would yield a fair and certain revenue. How to get them wired is the problem. Your advertising helps by bringing the householder to a realisation of the many advantages and conveniences of an electric service. Then it is a good plan for your canvasser to call in the day time, get the "lady of the house" on his side and then make an appointment for evening after supper, when the householder is likely to be in the right frame of mind, and the canvasser can meet wife (already predisposed in his favour) and husband together. May and June are especially good months to canvass residences in, because families who are out of town in July and August can arrange to have the wiring done in their absence, saving them some inconvenience.

But there are householders who would like to have an electric illumination who do not feel that they can afford to pay out the cost of wiring in a lump sum. If these be reputable citizens let the company help them out by financing the deal, the money to be repaid within a year in monthly instalments. If this wiring would cost $200 to $250, and that is more than the householder wants to spend, suggest to him that he wire his living rooms—dining-room, kitchen, cellar, back parlour, parlour and lower halls, which can be done within $100, including fixtures.

The above refers to cases where the tenant is also the owner. Where he is not the owner the difficulties multiply. Here is a plan or scheme that might prove efficacious under the latter circumstances, and is worth while trying where neither landlord nor tenant is willing to pay the complete cost of wiring. Approach the tenant and tell him that you can appreciate the fact that he is unwilling to spend from $100 to $250 in improving somebody else's property, but that it certainly is worth something to him and his family to enjoy the comforts, conveniences and elegancies of an electric service. Then make this proposition to him: If he will see his landlord and get the landlord to pay one-third the cost of wiring, and he (the tenant) will pay another third, the company will pay the remaining third of the bill. This ought to be an attractive and paying proposition for landlord, tenant and company.

You can secure residence lighting, also, planning on paper an appropriate illumination for some particular home, and interesting the resident in these plans. It is a case of being alive and hustling.

In pushing electric heating and cooking devices, some companies have acted in co-operation with the department stores. From personal experience, I should say it is better for us to do it alone and let the department store do the same. Our standpoints and purposes are widely different. The store sells the appliance for the profit in the sale, and the profit must be a large one, for sales are necessarily limited in number. The central station's object is not to make a profit on the sale, but to get the appliance on the system where it will use current. For a General Electric 6-lb. iron, for instance, the store charges $4; the iron cost the central station about $2.85, and the latter is glad to sell it for $3 if an arrangement with the store does not tie its hands; and you can sell four irons at $3 to one iron at $4.

The method which has been most successful in placing irons is to send them out on trial, putting one in every house equipped for an electric service. In the city of 50,000 or less, I would advise either using one of your canvassers for this purpose throughout the city, or else making each canvasser take care of his own district in this respect. Load the irons in an auto, and when leaving each iron for a trial of from 30 days to three months, have the canvasser give a little selling talk, and leave a neat circular calling attention to its many advantages. Also let him leave a postal card addressed to the company, explaining that it is possible, though not probable, in first using the iron that some trifling trouble may be experienced, in which case tell the customer not to condemn the iron but to send the postal card, when the company's representative will call and straighten out the kinks. The iron is all right, and if followed up in this way is bound to prove a boon to the housewife and a source of revenue to the company.

As a matter of fact, these irons could be given away with a profit by the central station. They cost, say, $3, and bring in a revenue, which begins the minute they are placed on the system, of about $1 a month. In three months the first outlay is returned, in six months the iron is completely paid for out of the profits, and becomes from that time a constant agent of profitable income. And it is day load, too. In those cities where you may fail in securing the $3 for the irons, give them away.

Other heating and cooking devices are not so valuable to the central station as the iron, but they all have their place in popularising current. You have your display of them in your showroom. Get up a "demonstration." Hire an attractive young lady to do the cooking, and send out invitations to your customers. Give them something dainty to eat and a small souvenir of the occasion. Have your advertising and your men follow this up, and you will sell a sufficient number of appliances to make it pay.

The use of electric fans can be increased by judicious advertising and canvassing; and if you are not afraid of complications with contractors and supply dealers, by selling them at a low figure—a price approximately cost. If you have considerable surplus supply, rent them out for the summer months.

I have purposely kept the subject of increasing the power business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and, at the same time, ordinarily the most difficult to secure.

First of all, let me say that while it is possible to secure lighting business at a higher price than is paid for other illuminants, because of superiority and also because average installations are of such size that isolated generating plants are impracticable, to get any large slice of new power business, your price has got to be right, for even if you can go into a factory and demonstrate how by cutting out friction load you can largely reduce the energy required to turn the wheels, if your rate for current is too high there is nothing to prevent the mill-owner from taking advantage of your trip, eliminating much belting and shafts, installing motors and putting in his own dynamo.

Power business is such good business that special effort to get it is well worth while. If within the limits of possibility make your rate right to begin with.

It is more difficult to secure a good power canvasser than the other kind. If your general agent is enough of a technician and sufficiently familiar with power problems to handle this end of the business, that is a tremendous help. If not, and there is much power business in your town, then, in addition to your other canvassers, you will have to hire a power expert.

The way to get power business is to get it. There must be energy, enterprise and indomitable tenacity on the part of your power man, backed up, on the part of the company, by a readiness to help and a willingness to be liberal. I know a general agent, who is also a power man in a manufacturing city of 25,000 inhabitants, who has got a big load of new power business for his company by use of the qualities I have mentioned. He goes into a factory, indicates, at the company's expense, the engines in use, figures out the energy saving he can effect by the use of motors, installed to the best advantage, finds out what its coal and water cost the factory, and has been enabled more than once to go in and win on a guarantee not to exceed for expense of operation these coal and water charges, getting eventually from 4 to 6 cents for the current. If the factory owners balk at the expense of motors, he offers to buy them and receive payment in instalments. If installation is going to interfere with the needed operation of machinery, he agrees to install the motors at night, on Sundays and holidays. The man has got ginger, and he does the business. He is now running not so very far away from that ideal condition where peak is nearly uniform for at least 12 hours per day. This man's example is a good one to follow.

There is one matter that your general agent and canvassers must not lose sight of. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The customer ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is of the utmost importance in more ways than one, retaining his good will. If the customer has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. Actually the old customers ought to constitute one of the most fruitful fields for new business. Don't neglect them.

The organisation for getting new business outlined in the foregoing has the advantage of being elastic. If you require fewer canvassers than you at first figured upon, it is easy enough to lop them off; if you need more, to get them. I believe that if the ideas and plans of action suggested or described in this paper are followed with a reasonable degree of faithfulness and a proper adaptation to the peculiarities and exigencies of the particular central station making the trial, the result will be such a large volume of new business that, besides more canvassers within a year, you will require three additional members of your commercial staff, as follows:

A man to take hold of contracts as soon as they are signed and follow them up until connection is accomplished.

A secretary or assistant to the general agent, who shall attend to the mass of correspondence, and fulfil the office function of the general agent while he is engaged on the outside on new business propositions.

A record and filing clerk to handle the reports of canvassers, make out orders, and assume systematic charge of the papers and records of the department.

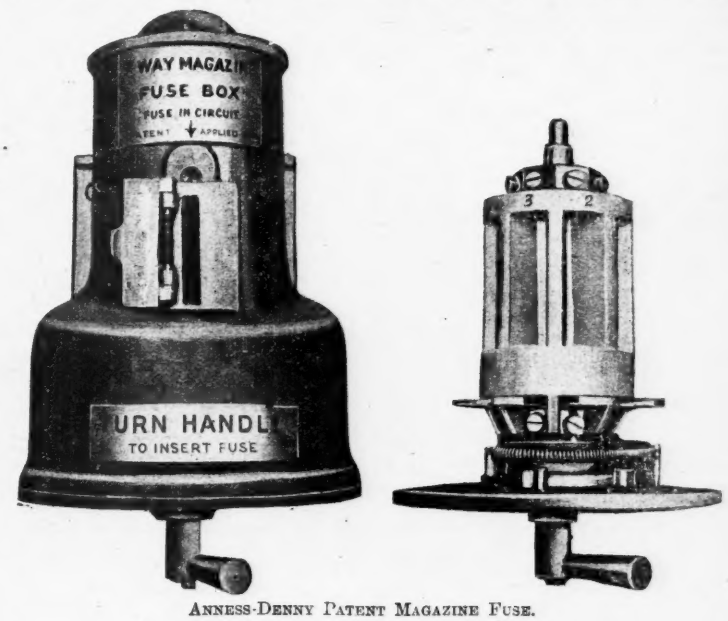
ENCLOSED MAGAZINE FUSE BOX.

The insertion of a new fuse on a main lead is often the occasion of considerable delay and loss of temper. An experienced workman, provided with the necessary tools, and above all, the correct size of fuse wire, has to be summoned before the fault can be rectified. To overcome these objections, Mr. E. G. Anness and Mr. C. W. Denny (of 88, Bouverie Road, Stoke Newington, N.) have designed a magazine fuse box, for the purpose of immediately introducing a fuse into a circuit by simply turning a handle.

The apparatus, an external and internal view of which we reproduce herewith, consists, briefly, of a porcelain drum or fuse-carrier, mounted on a wrought-iron spindle, so as to revolve between suitable metallic contacts. The porcelain drum is provided around its periphery with a series of longitudinal channels, separated from one another by walls of porcelain; in each of these channels a fuse wire is contained. The drum, contacts, and connections to external mains are all housed in a neat cast-iron case. On the front of the case is provided an inspection shutter, by which the fuse in circuit can be readily inspected; means are also provided by a small hole for seeing the number of fuses remaining in the box. The handle, which has a spring action, has only to be turned through about 45°, and by the action of a strong spring will fly back to the normal position, switching in a new fuse with a smart, snap-like action, and thereby preventing any burning of the contacts. Only one fuse can be in circuit at a time. The handle can only be turned in one direction, through a fixed range, thereby making the apparatus extremely simple and "fool-proof."

The magazine fuse can be made in several sizes and types for various voltages and currents, and as a minimum contains seven fuses. It is further proposed to construct magazine fuses for voltages above 600 volts, and for this purpose the ordinary fuse wire will be replaced by a dust fuse, which is of similar design to the well-known Mordey enclosed fuse. By this arrangement a high-tension circuit-breaker of limited capacity is obtained; that is to say, until all the fuses in the box have been used up. It is then only necessary to withdraw the drum and re-fuse it (which should be done by some authorised person), and seal up the case again.

The situations where such a magazine fuse box could be usefully applied are very numerous. Already its value has been indicated in connection with supply companies' mains to large buildings. If, of course, the consumer blew several fuses in succession, it would be time to advise the supply company of a fault, but often a main fuse "goes" through some momentary overload or through some passing carelessness. Its sphere of usefulness, however, is mainly found in power circuits. One fuse blows, and with no loss of time, mess or trouble, another is jumped into its place, while melting of the fuse wire can in no way earth the circuit or make the magazine inoperative.



Anness-Denny Patent Magazine Fuse.

POWER TRANSMISSION LINES.

By T. L. KOLKIN.

Several articles on the theory of transmitting electrical energy have recently appeared in some of the periodicals. It is, of course, of importance for the designer to be familiar with this theory, but it is of just as great importance to know how to use it to best advantage, and that is what the writer in the following article will endeavour to demonstrate.

In laying out a transmission line the following points have to be taken into consideration :—

1. *Mechanical strength*—not only of the poles and insulators, but also of the wires. A certain wire may be found to be of sufficient size to take care of the voltage drop, but if it does not possess a sufficient mechanical strength, the use of such a wire will lead to bad results.

2. *Current Density.*—Before deciding upon a certain size of conductor, it is necessary to make sure that the heating current does not exceed a certain limit per unit of the sectional area, especially where cables are used. A current density of 1,500—1,800 amperes per sq. in. is, as a rule, the maximum allowed for overhead wires. The current density for cables will be found in the rules of the I.E.E.

3. *Voltage Drop and Regulation.*—This is a point which should receive careful investigation, especially where large motors doing intermittent service are installed, and where the torque limits the output of the motors. It must be remembered that in the case of a three-phase system a 10 per cent. drop below the full voltage on the motor means about 19 per cent. less torque; or, in other words, the customer receives only about 81 per cent. of the torque he has "installed."

4. *Whether the energy is to be used* for power or for lighting; in case the energy is to be used for driving motors it is necessary to know the size of the motors. For instance, a 25-H.P. motor, two or three-phase, can be wound for 1,000 volts, a 40-H.P. motor can be wound for 2,000 volts, and a 50-H.P. motor can be wound for 3,000 volts. Motors wound for a higher voltage than 3,000 volts very seldom come into consideration; for instance, where motor-generators of considerable size are to be installed. In case the drive is such that high tension motors can be used, it should be investigated whether the energy can be transmitted at such a voltage that step-down transformers are required only for the smaller motors, or whether it would be of advantage to transmit at a higher voltage and use step-down transformers for all motors.

5. *Restrictions or Difficulties* in obtaining wayleaves, &c., may limit the voltage, and have, of course, to be taken into consideration.

6. *Situation of Plant.*—It is, undoubtedly, more difficult to repair a high tension motor than a low tension motor. High tension motors should, therefore, not be used where very good skilled labour is not obtainable. Climatic conditions have further to be considered, as to whether the climate is dry or moist, &c.

7. *Possibility of Shutting Down* the line in case of emergency.—In many cases it will be found that a certain percentage of the total load has always to be available, and that a shutting-down of the transmission line even for a few hours would cause great inconvenience and loss. In such cases it is necessary to put down two or more independent circuits. The maximum power to be transmitted with one circuit shut down, or mechanical reasons, may necessitate putting down a larger line than is actually required in ordinary service. I think the importance of this item is, as a rule, under-estimated.

8. *Cost of energy or coal.*

9. *Cost of the transmission line.*

10. *Working time and working conditions* of the various motors, or better still, a 24-hours load curve.

By means of 8, 9 and 10 the "most economical" size of conductors can be determined (by the application of Kelvin's law). If items 1 to 7, however, have received proper consideration

there is, in many cases, not much room left for a strict application of this law.

It will easily be understood from the above that a general rule as to what voltage should be used cannot be given. As a guide, I find that under ordinary circumstances—

$$\text{Voltage} = 150\text{-}200 \sqrt{\text{KW.}} \times \sqrt[3]{\text{distance in miles}}$$

gives fairly good results. For instance, for transmitting 1,600 KW. over a distance of 36 miles this would give—

$$v = 150\text{-}200 \sqrt{1{,}600} \times \sqrt[3]{36} = 20{,}000\text{-}25{,}500 \text{ v.}$$

Effect of the Wind Pressure.

In the following we will investigate from what size of wires we can expect a good result as far as mechanical strength is concerned, and, at the same time, draw a comparison between copper and aluminium. The strain on the suspended wire is due to—

1. Weight of the wire.
2. Wind pressure.
3. Weight of snow and ice on the wire.

The strain per unit of cross-sectional area due to the weight of the wire is evidently independent of the size of the wire. With the strain due to the wind-pressure this is, however, not the case. As regards snow and ice, this acts practically in the same way as the weight of the wire. In this country it is hardly necessary to take snow and ice into consideration—at any rate, not simultaneously with maximum wind pressure.

For determining the wind pressure, I will use the usual formula for cylindrical surfaces, which is—Pressure $= \frac{2}{3} 125 \times d \times l$ in kg. per m.^{2}, where d is the diameter and l the length of the cylinder (wire) in metres. Assuming—

s = section of wire in mm.^{2},
p = weight of wire in kg. per m.,
p_1 = wind pressure on wire in kg. per m.,
p_2 = resultant of p and $p_1 = \sqrt{p^2 + p_1^2}$ in kg. per m.

We have then—

TABLE I.—Copper.

s	p	p_1	p_2	$c = \frac{p_2}{p}$	d in mm.
10	·087	·307	·31	3·6	3·7
20	·174	·423	·48	2·7	5·1
40	·348	·597	·696	2·0	7·2
80	·696	·83	1·08	1·54	10·0

TABLE II.—Aluminium.

s	p	p_1	p_2	$c = \frac{p_2}{p}$	d in mm.
20	·054	·423	·43	8	5·1
40	·108	·597	·608	5·6	7·2
80	·216	·83	·94	4·3	10·0
160	·432	1·16	1·23	2·9	14·3

Fig. 1 shows the relationship between s and c. In the case of copper we find that for a wire of 10 mm. section,

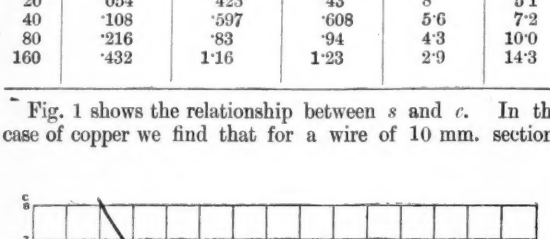


Fig. 1.

the resulting strain is 3·6 times the strain due to the weight of the wire. It will be noticed that c is rapidly decreasing for wires up to, say, 30-40 mm.^{2} section, while from this point the decrease is less marked. This shows that we can expect better results as regards mechanical strength from large wires than from small ones, and that wires of less than 30-40 mm.^{2} section should not be used—say, wire No. 3 S.W.G.—except, of course, for short distributors.

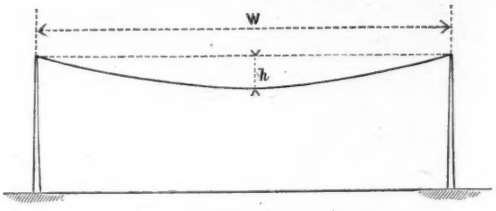


Fig. 2.

In the case of aluminium, we find that the limit is about at 60-70 mm.^{2} section, or No. 00 S.W.G.

Influence of the Temperature.—We will now consider what influence the fluctuation of the temperature has on the strain to which the transmission line is subject.

Referring to fig. 2, we will call—

t = temperature in C.°,
α = coefficient of temperature,
σ = strain per unit of section,
s = section of wire,
p = weight of wire per unit of length,
Σ = modulus of elasticity,
l_0 = length of wire at $t = 0$ and $\sigma = 0$,
l = length of wire at a certain t and σ,
λ = modulus of elongation.

And we find—

$$l = (l_0 + l_0 \lambda)(1 + \alpha t),$$

and $\frac{\sigma}{\lambda}$ being $= \Sigma$,

$$l = l_0\left(1 + \frac{\sigma}{\Sigma}\right)(1 + \alpha t) = l_0\left(1 + \alpha t + \frac{\sigma}{\Sigma} + \frac{\alpha t \sigma}{\Sigma}\right).$$

$\frac{\alpha t \sigma}{\Sigma}$ is so small that for all practical purposes it can be neglected, and we have—

$$l = l_0\left(1 + \alpha t + \frac{\sigma}{\Sigma}\right) \quad \ldots \quad \ldots \quad (1)$$

Owing to the sag being very small as compared with l, we can in this case use the well-known formula—

$$l = w + \frac{8}{3}\frac{h^2}{w}, \quad \ldots \quad (2)$$

where h is the sag, and w = the length of the span.

We further know that the sag—

$$h = \frac{p w^2}{8 \sigma s}, \quad \ldots \quad \ldots \quad (3)$$

and from (2) and (3) we find—

$$l = w + \frac{p^2 w^3}{24 \sigma^2 s^2}.$$

Thus $$l = l_0\left(1 + \alpha t + \frac{\sigma}{\Sigma}\right) = w + \frac{p^2 w^3}{24 \sigma^2 s^2},$$

and $$t = \frac{1}{\alpha}\left(\frac{w - l_0}{l_0} - \frac{\sigma}{\Sigma} + \frac{p^2 w^3}{24 \sigma^2 s^2 l_0}\right). \quad (4)$$

$\frac{w}{l_0}$ is practically $= 1$, so that—

$$\frac{w - l_0}{l_0} = \alpha t + \frac{\sigma}{\Sigma} - \frac{p^2 w^2}{24 \sigma^2 s^2}. \quad (5)$$

We are now in a position to calculate $\frac{w - l_0}{l_0}$, which in connection with (4) enables us to determine the relation between t and σ. It is clear that t_{min} and σ_{max} determine $\frac{w - l_0}{l_0}$. We will assume a minimum temperature of $-30°$ C., and that we have a coefficient of safety of, say, 4 at the above temperature, and at the wind pressure pre-

viously assumed; the breaking strain of hard drawn copper is about 40 kg. per mm.^{2}; σ_{max} would thus be about 10 kg. For aluminium we would have a σ_{max} of about 6 kg. per mm^2. Tables III and IV give the value of $\frac{w - l_0}{l_0}$ for the above t_{min} and σ_{max} at spans of 30 m., 50 m. and 100 m.

TABLE III.—Copper.

$\Sigma = 13{,}000$, $\sigma = \frac{1}{58{,}200} = 0{\cdot}0000172$.

s	at $w = 30$ m.	at $w = 50$ m.	at $w = 100$ m.
	$\frac{w - l_0}{l_0}$		
20	+ 0·0000324	− 0·000359	− 0·00219728
40	+ 0·000144	− 0·000058025	− 0·0009929
80	+ 0·00018511	+ 0·0000639	− 0·000505

TABLE IV.—Aluminium.

$\Sigma = 7{,}100$ $\alpha = 0{\cdot}0000234$.

s	at $w = 30$ m.	at $w = 50$ m.	at $w = 100$ m.
	$\frac{w - l_0}{l_0}$		
40	− 0·000099	− 0·00062734	− 0·00293836
80	+ 0·0000005	− 0·000251725	− 0·0014359
160	+ 0·0000808	− 0·00002929	− 0·00054616

$\frac{w - l_0}{l_0}$ = positive, means that the span is longer than the length of the suspended wire at $t = 0°$ and $\sigma = 0$.

This shows that practically nothing need be allowed for sag, for copper wires, if the average length of spans does not exceed 40 to 50 metres.

(*To be concluded.*)

BUSINESS NOTES.

"P.D.M." Contracts.—Among work recently executed and started up by the Phœnix Dynamo Manufacturing Co. is a 600-kw. set for the Gloucester Corporation, the dynamo for which, we understand, has recently gone through very satisfactory trials. This is coupled to an engine by Messrs. W. Sisson & Co., running at 280 r.p.m. For the Johannesburg municipality, to the specification of Messrs. Mordey & Dawbarn, and to the order of Messrs. D. Stewart & Co., they have recently completed four motors which are rather abnormal as regards the conditions under which they have to run; they are for driving blowers in connection with gas plant, and were required to give an output of 54 b.h.p. at any speed between 175 and 700 r.p.m. when running on a 460-volt circuit, the said speed regulation being obtained entirely by means of field regulation. These, in common with all the large machines recently made by them, are of their "Phœnix Pohl" type, and the above four machines went through an exhaustive series of tests by the consulting engineers, in which we are informed the specified conditions were most satisfactorily obtained, the machines having an abnormal overload capacity at any speed. For the West Riding County Council, to the order of S. Dixon & Sons, they have recently completed two 80-kw. sets with Willans & Robinson's engines; for the Barrow-in-Furness Corporation electricity department they have recently completed and installed a balancer booster set; for the Great Western Railway works at Swindon they are now delivering three 165-kw. slow speed sets, running at 200 r.p.m. for direct coupling to gas engines. Among contracts recently taken may be mentioned a 200-kw. set with Messrs. Willans & Robinson's engine for the Nuneaton Electricity Works; a contract for auxiliary machinery for the Birmingham Corporation consisting of two 100-kw. balancer sets; one 200-kw. motor-generator; four 50-kw. balancer booster sets, and two trunk main feeder boosters, each set to consist of two 42-kw. machines with motor for driving same. The total horse-power of the Birmingham order is approximately 2,100. For the Farnley Iron Co., Leeds, they have on order a special dynamo for direct-coupling to a Premier gas engine, the output being 140 kw. at 105 r.p.m. For the South African Technical College, Cape Town, they have received orders for the complete equipment of their electrical laboratories, there being some £600 of plant thus required. For the Kent Electric Power Co. they are supplying some 350-h.p. three-phase motors and motor-generators. For the Campbell Gas Engine Co., Halifax, to the specification of Messrs. Shepherd & Watney, the company have on order seven motors, totalling 400 h.p., while for the Urban Electric Supply Co., at Hawick, they have recently delivered motors totalling 200 h.p. We understand that the Phœnix Dynamo Co. have machines on order totalling 5,000 h.p. They report that the sale of their electric drilling machine is proceeding satisfactorily, and that they have recently placed upon the market a Bench type electric grinding machine. They are also now proceeding to introduce a new starting switch, the "Dix-Sandford" patent, which combines several novel features.

Prices Advance.—The Electrical Power Storage Co., Ltd., announce that owing to the continued increase in the price of all raw materials, they are compelled to make a further increase in prices, to take effect as from 10th inst. All prices in their 1903 list are increased as follows:—Renewal sections, page 30, 15 per cent.; all other prices 10 per cent.

Book Notices.—*Gas Works Directory and Statistics*, 1906-7. London: Hazell, Watson & Viney, Ltd. 10s. 6d. net.—We have received a copy of this directory for the current year. It gives in convenient form particulars of all the various gas supply undertakings in the kingdom, the information being of the same character as that to which we are accustomed in electric lighting works' statistics. The officials of the different companies and works are stated, and the price of gas (a thing the electrical promoter generally likes to know before he applies for a prov. order) is given in every case. Wherever an electricity works is operating the fact is indicated. An alphabetical index to officials is given at the commencement of the directory, and at the end there is a list of foreign and colonial gas works having offices in London. The information given in the book is corrected up to July, 1906.

Elementary Manual on Applied Mechanics. By Andrew Jamieson, M.Inst.C.E. London: Charles Griffin & Co. 1906. Price 3s. 6d.—This is the seventh edition of this Manual, a fact which might be left to speak for itself. We note, however, that in addition to the usual revision, the book has been enlarged by about 100 pages, with over 40 new illustrations. The new matter embraces centrifugal pumps, the laws of falling bodies and projectiles, energy stored in fly-wheels, torsion of rods and wires, loading of beams, &c. New test questions have been added, and recent examination papers. A wonderful variety of subjects is dealt with in the book, illustrative examples drawn from actual practice forming a prominent feature of its contents. The author has a natural gift for lucid exposition, a quality especially valuable in writing for elementary students, and this is well seconded by the numerous and clear illustrations. Most of the latter are line drawings or wood-cuts, and therefore, with few exceptions, they print up well. The punctuation might be improved in some of the newer parts, where, for some reason, commas are unduly plentiful. The author does not attempt to impose the academic "poundal upon his readers," though, as in duty bound, he defines it in a foot-note; curiously enough, he twice defines the engineer's unit of mass, on consecutive pages (pp. 289 and 290). The use of the word "power" to denote force is severely condemned, but the letter P is frequently employed to represent a force; the difficulty which this introduces is ingeniously circumvented by describing the force as a "pull." These, though apparently minor points, are of importance, not merely as helping the students to true conceptions of the quantities concerned, but also as indications of the care exercised by the author in eliminating the pitfalls which so frequently have marred the pages of text-books on mechanics. The work is one which should not only instruct, but also engage the interest of the student, an essential factor in all stages of his education, and pre-eminently so in the early stages.

Engineering Standards Committee's Reports.—Quite a number of these Reports have recently been issued, several having a more or less direct bearing on electrical engineering. No. 31 contains the British Standard Specification for Steel Conduits for Electrical Wiring; it admits close-joint, brazed, welded and solid-drawn tubes of mild steel, stove-enamelled or galvanised inside and out. Two classes are recognised—A, plain light-gauge unscrewed conduit, and B, heavy-gauge screwed conduit, with Whitworth pipe threads, as defined in a previous Report (No. 21). Both classes are to be of the dimensions given in a table, and are to be made in lengths of 10, 12 or 14 ft. The dimensions of the sockets and couplers are also specified, as well as the radii of bends. Limit gauges are recommended for gauging the outside diameters, while the thicknesses should be determined by weighing a quantity measuring not less than 100 ft. in length; screwed (not limit) gauges made in accordance with the Report above mentioned are to be used for judging the fit of threads. Seven gauges are required for each standard size of conduit, socket and coupler; all the dimensions, however, are included in one small table. The diameters range from ⅜ in. to 2 in., and the thicknesses (Class A) from 0·040 to 0·064 in., (Class B) from 0·064 to 0·092 in.

Report No. 25 deals with Errors in Workmanship, based on measurements carried out for the Committee by the National Physical Laboratory, at the works of a number of leading manufacturers. For the purpose of this investigation the measurements were confined to plain cylindrical work, in connection with locomotives, gun mountings, gas engines, dynamos, high-speed engines and machine tools. "Tolerance" is defined as "a difference in dimensions, prescribed in order to tolerate unavoidable imperfections of workmanship." "Allowance" is "a difference in dimensions prescribed in order to allow of various qualities of fit." "Clearance" is "a difference in dimensions or shape prescribed in order that two surfaces or parts of surfaces may be clear of one another." Of these three quantities, only tolerance was to be standardised, allowance

and clearance being left to the discretion of manufacturers. The analysis of the data obtained is very complete, many tables and diagrams being given. It appears from these that in practice the average error in workmanship is but little affected by the actual size of the work; measurements on 456 shafts showed a total error of 1·6 mils, of which 0·5 mil was + and 1·1 mils −; the average departure from the exact dimension therefore was less than one-thousandth of an inch, a very satisfactory result. In the case of holes (329 measured) the total error was 1·8 mils, of which 1·4 mils was in excess of the correct size and 0·4 in defect—a result nearly as good as the former. Work manufactured to limit gauges came out with flying colours, the total error on shafts averaging 0·85 mil, an average departure from perfection of less than half a mil; accuracy in boring holes is more difficult of attainment, and the total error was 1·2 mils, but even here the ± error was but little more than half a mil. The tendency observable, as might be anticipated, is to finish shafts rather under than over the correct size, and *vice versâ* in the case of holes, to ensure the parts coming together. Turning to classified tables, it is very pleasing to note that next to small tools, which have a *total* average error of only 0·5 mil, high speed engine and dynamo shafts are at the head of the list with a total average error of 1·1 mils. Gas engines run to 2 mils, large machine tools to 2·5, and locomotives to 3·1 mils. In the case of holes, high speed engines and dynamos actually reach the summit, for while the total average error in the case of small tools is 1·0 mil, it is entirely +; engines and dynamos have the same total average error, but it is nearly equally distributed on either side of the true size (+ 0·6, − 0·4), and is therefore practically half as great. No fewer than 24 per cent. of the holes measured in this class showed no error. As regards uniformity in dimensions along the specimens, ground shafts show a marked superiority over all others, only 16 per cent. having a maximum variation of 1 mil or more. The limits of tolerance recommended by the Committee are practically the same as those suggested by one of its members—Mr. Robert Matthews, of Messrs. Sir W. G. Armstrong, Whitworth and Co., Ltd.—and approximately follow the law

$$\tfrac{1}{2} \text{ limit} = \pm (0{\cdot}1\ D + 0{\cdot}5)$$

where D is the diameter in inches and the limit is expressed in mils; but above 5 in. the slope is reduced, to allow the limiting lines to pass through points representing ± 0·0015 in. at 12 in., making the total tolerance at that diameter 0·003 in. Much valuable information regarding current usage in connection with running, sliding and force fits is given in the Report, which should prove a valuable work of reference.

Report No. 27 gives the conclusions of the Committee as to Standard Limit Gauges for running fits, based on the foregoing Report. Three general classes of workmanship are defined, and an extra fine class for special work. The Committee recommends, for running fits, that the shaft shall be the element more nearly approaching the true dimension, and allowance be made on the hole. Taking a 5-in. shaft as an example, in the first class, the tolerance is 2 mils; the limits of diameter prescribed are 5·000 and 4·998 in. The allowance is 2 mils, and the limits of diameter of the hole are 5·002 and 5·004 in. In second-class work the tolerances and allowance each become 4 mils, and in third-class work they are 6 mils on the shaft, 8 mils allowance and 8 mils on the hole. The range in first-class work is from ·5, ·5 and ·3 mil on a diameter of ¼ in. to 3, 3 and 3 mils on a diameter of 12 in. Tables give the data for sizes advancing by 1 in., and a diagram is added embodying the whole of the standards.

Report No. 15 deals with Structural Steel for Bridges and Buildings, and covers plates, bars, rods, &c., specifying the composition, strength and ductility of the materials, with dimensions of tensile test pieces.

Report No. 24 relates to materials used in the construction of Railway Rolling Stock, and includes 19 specifications, covering the great bulk of the metal parts employed for this purpose. This report is regarded as one of the most important of the series, and has been in course of preparation for over four years. It applies more directly to locomotive construction, but a large part of it is applicable also to carriage and wagon building, and necessarily its contents are of great interest and value to electrical engineers engaged in tramway and railway work.

Lastly, Report No. 28 deals with Nuts, Bolt-heads and Spanners, regularising the shapes and sizes of these parts, and giving tables of dimensions.

The excellent work which has been and is being done by the Engineering Standards Committee, and the energy which it has displayed in pressing forward its operations simultaneously in so many different directions, compel our admiration, and will without doubt bear fruit abundantly to the advantage of British industry in the future. There is still an immense field open for the Committee's labours, including some regions of the first importance to electrical men, and we confidently count upon its dealing with these in due course no less successfully than with those already traversed.

"Transactions of the N.E. Coast Institution of Engineers and Shipbuilders." Vol. XXII, Parts 8 and 9. August, 1906. Newcastle-on-Tyne: the Institution, 4, St. Nicholas Buildings West.

"The *Electrician* Primers." Complete in one volume. Edited by W. R. Cooper. London: The *Electrician* Printing and Publishing Co., Ltd. 10s. 6d. net.

"Applied Electricity." By J. Paley Yorke. London: Edward Arnold. 7s. 6d.

Cricket Match.—On Saturday last the annual cricket match between the Birmingham Works of the General Electric Co., Ltd., and the Robertson Electric Lamp Works, took place at Old Oak Road Ground, Shepherd's Bush. The Hammersmith Works batted first, and made a very disastrous start, losing five wickets for 19 runs; Parrott, however, came to the rescue, and after making a useful 34, he was rather unlucky in being run out. The last two wickets brought the score up to 67. The Birmingham Works also started badly, losing five wickets for 21 runs, until Morris, a very promising batsman, gave a fine exhibition, making 48 before being bowled by Furnell. The remaining players brought the Birmingham total up to 103. In the evening both teams had dinner at the Clarendon Hotel, Hammersmith, followed by a smoking concert.

Meter-Card Holder.—Mr. N. A. Chesterfield, of the Fulham Electricity Works, has invented a patent holder for meter-cards; it is a device for attachment to the case of either gas, electricity or water meters, with a mica face, so that the card is always in its place and readable. It is claimed that the card always being with the meter, an absolute record is kept; the card is always to be found, and is kept clean; meter readers are not delayed whilst consumers find their cards, therefore trouble and inconvenience to both consumers and supply authority are saved. Further particulars may be obtained on application to Mr. N. A. Chesterfield.

Catalogues and Lists.—Messrs. John Spencer, Ltd., Wednesbury.—Trade price list of wrought-iron gas, steam and water-tubes and fittings.

Messrs. James Archdale & Co., Ltd., Ledsam Street, Birmingham.—This firm have issued a new edition of their catalogue of machine tools. Numerous high-speed radial drilling machines, multiple spindle machines, various high-speed cutting lathes, screw-cutting, turret and other lathes, horizontal and vertical milling machines, boring, planing, slotting, shaping and shearing machines and so forth, are illustrated and briefly described. Special attention should be directed to a special line of improved high-speed drilling machines and high-speed and capstan lathes. A large number of examples are included of motor-driven machines. A list of code words and some useful measurement and other general information, also some rules for gear-cutting, are given at the end of this handy-sized and well-produced book of 234 pages.

Messrs. Johnson & Phillips, Ltd., Charlton.—New list (No. 14) containing 40 pages of information concerning vulcanised india-rubber cables made to the Cable-Makers' Association's standard grades, also relating to non-association wires and cables. A double page table is given of pure copper conductors arranged in order of carrying capacity. The various sections relating to the different grades of cables are conveniently indicated by means of a thumb index. Several pages give prices and sizes of fittings wire, cotton and silk-covered wires and flexible cords. A long list of places where J. and P. cables are used brings up to the rear. Messrs. Johnson & Phillips have recently extended their electric cable works, and have erected new machinery with all the latest improvements. A copy of this catalogue will be forwarded to anyone interested.

The Lancashire Dynamo and Motor Co., Ltd., Trafford Park.—40 pp. illustrated catalogue (for filing with previous lists), giving very full particulars concerning their four-pole continuous current machines. A full specification of enclosed and semi-enclosed motors and dynamos with half-tone views of parts and complete machines, is printed, and particulars of sizes, B.H.P. and speed, code-words, prices, &c., for shunt or compound-wound and series-wound, are given. Dimensional and shipping particulars are also tabulated.

General Electric de France, Ltd., 11 bis, Rue de Maubeuge, Paris.—Section "G" of the company's catalogue. It gives particulars in French, also illustrations and tables of prices of Union steel conduits and fittings, wires, cables and insulators and wiremen's tools.

Messrs. George Hatch, Ltd., Queenhithe, Upper Thames Street, E.C.—Small abridged pocket edition of their catalogue, in which a few of their engineering specialities are shown and priced, including screwing machines, chain pipe vice, lifting jacks, pipe bender, ratchet braces, pulley blocks, belting, packing, and so forth.

Messrs. Hodgson Wright & Wood, Century Works, Pellon Lane, Halifax.—Price Lists No. 18, shunt-wound dynamos, from 12 to 85 KW.; No. 19, single-phase motors for 50 cycles, 0·2 to 9 H.P.; and No. 20, two and three-phase motors, 50 cycles, 1½ to 10 H.P.

Messrs. Geipel & Lange, St. Thomas Street, S.E.—New illustrated list, giving full details with prices, code-words, and constructional particulars of the Ward-Leonard field rheostats, in which many improvements in detail are said to have been made, rendering the apparatus more in accordance with modern English practice. Considerable reductions in prices are noted.

Messrs. Bruce Peebles & Co., Ltd.—Pamphlet No. 13, containing a specification of the general construction of their P.P.P. polyphase alternators. The windings, parts of machines, and complete sets supplied by the firm are finely illustrated on art paper. The pictures include a group of four 1,500-KW. three-phase, 10,000-volt alternators installed for the North Wales Power and Traction Co., Ltd, 500-KW. single-phase alternator at Burton-on-Trent, two 400-KW. two-phase alternators for the Fife Electric Power Co., &c. Details are tabulated of weights and prices of 1906 type alternators for 50 and 25 cycles respectively. The matter in this pamphlet is not at all cramped, and in its general setting the convenience of the prospective buyer who wants to easily ascertain the particulars of a machine suitable for his specific service has been studied.

Messrs. Siemens Bros.' Dynamo Works, Ltd., Westminster, S.W.—Several new pamphlets and circulars for filing in their blue binders, already distributed. Circular YM113 gives a general descrip-

tion of the better known types of Siemens-Schuckert electricity meters. These are listed in Price List 5A, a copy of which was circulated recently, and to which the present circular is intended to be an accessory. Circular YM114 describes the Siemens electric rock drills, which are wound for three-phase or continuous current at pressures not exceeding 300 volts. They are very portable, weighing only about 110 lb., and can be removed by taking out three bolts. They strike from 400 to 500 blows per minute. At the end an interesting record is given of one year's working of two 1-H.P. drills. Pamphlet YM3B is intended to supersede Pamphlet YM3A; it describes the Siemens-Ilgner electric winding system. Additional illustrations and calculations are given, and the list of installations has been considerably extended. Pamphlet YM15 is a new illustrated pamphlet showing examples of tools and machinery driven by Siemens motors. The examples range from a sewing machine to a colliery winding engine. All of these lists are fully and well illustrated, and their general arrangement and get-up are in the excellent style which usually characterises the Siemens publications.

MESSRS. MARPLES, LEACH & Co., London, E.C.—Circular showing and briefly describing their lampholder fan for D.C. and A.C. Also a circular giving a list of their various publications, a complete set of which may be obtained on application.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton.—Sheet tabulating types, powers, speeds, pressures, windings and prices of a number of surplus lines of new and second-hand dynamos that they have in stock.

Bankruptcy Proceedings.—T. C. HODGKINSON (electro-Neurotone), dealer in electro-medical apparatus, Goldhawk Road, Shepherd's Bush, London, W.—September 22nd is the last day for receipt of proofs for intended dividend. Percy Coles, trustee, Tower Chambers, Moorgate Street, E.C.

Plant for Sale.—The Board of Public Works, Dublin, is offering certain electrical plant for sale. Particulars appear among our advertisements to-day.

On September 25th MESSRS. WHEATLEY KIRK, PRICE & Co. will offer various electrical and other plant, stock and materials for sale by auction at Hampton Wick (Christian & Phipps, Ltd., in liquidation). Some particulars appear among our advertisements to-day.

Dissolutions and Liquidations.—COOPER PATENT "ANCHOR" RAIL JOINT CO., LTD.—This company is winding up voluntarily, with Mr. Wm. Crosland, 43, Albion Street, Leeds, as liquidator.

EMPIRE ELECTRIC LIGHT AND POWER CO., LTD.—The first meeting of creditors is to be held on October 2nd, at 11.30 a.m., and that of contributories on the same day at noon, both at 33, Carey Street, W.C.

Trade Announcements.—We learn that the new works that are being built at Tinsley, Sheffield, by the BROTHERHOOD-CROCKER MOTORS, LTD., of 19, Hanover Square, London, W., are now nearing completion, and in a few weeks will be ready for occupation by this company for the production of the Brotherhood cars. The new works are being erected on the most up-to-date lines, specially for the manufacture of the highest class of cars, being all on the ground floor, with north lighting. The main shop is composed of five bays, each 240 ft. long, in addition to which are other buildings comprising the smiths', hardening, engine testing, car testing, running shed, pattern making, &c., shops, whilst the front of the building is occupied by the administrative offices. The works are to be equipped with special plant and tools embodying the latest practice in motor-car manufacture and construction. A large proportion of this special machinery is only awaiting completion of the building, to be installed. In the past the company have made all the parts of their cars with the exception of the engine and gear boxes, but in their new works it is their intention to make all the parts of the car throughout.

We learn that the business carried on by HOLLAND HOUSE ELECTRICAL MANUFACTURING CO., LTD., of 9, Holland Place, Glasgow, has been acquired by a new company called HOLLAND HOUSE ELECTRICAL CO., LTD., which has recently been formed for this purpose. The old company was established in 1889, under the name of Munro's Electrical Manufacturing Co., Ltd., with, as nucleus, the manufacturing and repairing branch of one of the oldest electrical contracting businesses in Glasgow. In the interval several changes of a minor character, including the change of the company's name, have taken place in the economy of the company, necessitated by the alterations in working conditions, and the expansion of the electrical industry generally; and one result of this present re-organisation being the conclusion of the connection between the company and the above-mentioned contracting firm, the sphere of its labours should be correspondingly enlarged. The active general management of the new company will be in the hands of Mr. Harold Watson, A.M.I.E.E., the managing director and secretary, and of Mr. James McFarlane, the works manager, both of whom have been closely associated with the work of the company throughout its various stages of development.

MESSRS. HASLAM & SCHONTHEIL, of Western Mail Chambers, Cardiff, have been appointed by the Adams Manufacturing Co., of London and Bedford, agents for the sale of their "Igranic" motor and dynamo controlling apparatus in the South Wales district.

MESSRS. LIND & Co., 60, Castle Street, Liverpool, have been appointed by the Wandsworth Electrical Manufacturing Co., Ltd., to be their sole agents for Liverpool, West Lancashire and district, and they will carry large stocks of the company's manufactures.

Owing to increased business, MESSRS. R. J. NICHOLSON & Co. have removed from 26, Cannon Street, Manchester, to more extensive premises at Macdonald's Lane, Corporation Street, and all correspondence should be sent to the new address. As soon as the necessary arrangements are completed a showroom will be opened for the display of their "Ideal" lighting outfits, the extensive demand for which has been the principal cause of the removal.

Boiler House Economies.—The interest now being displayed in boiler house economies is particularly gratifying to the well-wishers of British manufactures. The following is a list of orders and contracts secured by MESSRS. E. BENNIS & CO., LTD., for electricity works during the last three months:—

Four stokers and C.A.F. coal elevating and conveying plant (repeat order); Coventry Corporation Electricity Works.
Twenty chain-grate stokers; City of Leeds Electricity Department.
Two stokers and C.A.F., one automatic steam pressure regulator; Accrington Corporation Electricity Works.
Ten stokers and C.A.F. (repeat order); Lancashire United Tramways Co., Ltd., Atherton (per Yates & Thom).
Four chain-grate stokers for Stirling boilers; Pumpherston Oil Co., Ltd., Mid-Calder, N.B.
Five chain-grate stokers; Madras Electric Supply Station, India (per Stirling Boiler Co., Ltd.).
Two chain-grate stokers; Madras Tramways, Madras, India (per Electric Construction Co., Ltd., Wolverhampton).
Seven stokers and C.A.F. for "E. & W." boilers; Strand Electric Lighting Co., Ltd., Sydney, N.S.W.

Besides these many similar contracts have been booked from flour mills, paper mills, cotton spinners, brewers, gunpowder works and so forth. A full list of these which we have received shows upon analysis 64 "Bennis" patent gold medal machine stokers and compressed air furnaces; 32 "Bennis-Miller-Bennett" new patent chain-grate stokers; six sets of "Bennis" coal elevating and conveying plant; one "Westminster" engine; and one automatic steam pressure regulator. One of the most suggestive features of the list is the order for 20 chain-grate stokers for the Leeds Corporation electricity works, the municipality of Leeds having, after an exhaustive inquiry, decided in favour of the new "Bennis-Miller-Bennett" chain-grate stoker for use with its installation of Babcock & Wilcox boilers. The halved links adjusting the air supply, and the absence of the troublesome dumping bar in this new patent, are claimed as strong points that appeal very forcibly to engineers in charge of such boiler houses as that at Leeds.

Japanese Electrical Developments.—A Lancashire correspondent of the *Daily News* reports that representatives of Japanese spinning and manufacturing firms are now instituting inquiries, quietly and unobtrusively, in Lancashire, respecting the adoption of electricity in cotton mills, with the view, no doubt, of adopting similar motive power in their own factories in the near future. The Japanese intend to have all the latest labour and expense-saving devices in their factories, as they purpose making a bold bid for the capture of a big portion of the Far Eastern trade in cotton goods. "Japan has now between 50 and 60 spinning mills, containing nearly 2,000,000 spindles, in addition to some 8,000 or 9,000 looms, employing many thousands of native operatives. Textile machinery makers in Lancashire have been busily engaged for some time past in dispatching consignments of machinery to the land of the Mikado, and the electrical manufacturers' opportunity will arrive ere long in the new cotton-spinning and manufacturing country."

Iron Tube Prices Advance.—According to the *Standard*, circulars were issued by all the leading houses in the English and Scotch wrought-iron tube trade on Monday, announcing an advance in prices of from 7½ to 8½ per cent. on the net. The advance is effected by a reduction in the gross discount of 2½ per cent. All classes of tubes participate.

LIGHTING and POWER NOTES.

Aspull.—The B. of T. has deferred consideration of the revocation of the E.L. order obtained by the U.D.C. in 1901 for six months. Negotiations will now be entered on with a view to obtaining a supply of energy in bulk from Wigan T.C.

Australia.—NEWCASTLE, N.S.W.—It is expected that new plant, which has been obtained at a cost of about £10,000, will be started up at the end of this month, at the municipal electricity works.

Bath.—The B. of T. has written to the R.D.C. asking what the Council proposed to do with regard to the E.L. order granted two years ago, and which expired on August 12th last. The Council has replied that in applying for the order it expected to obtain energy in bulk from the Somerset Power Co., but having experienced difficulties in the matter, it was still waiting in the hope that a supply would be available later on. The order has cost the ratepayers about £600.

Blackpool.—Experiments in street lighting with 2,700-C.P. Excello flame arc lamps have recently been conducted with success. Probably about 140 of these lamps will be installed, at a cost of £1,100.

Canada.—OTTAWA.—Inquiries are being made into the available water-power and deposits of iron in the Ottawa Valley with a view, should the investigations be favourable, to the establishment of a large electric smelting plant.

Carlisle.—The L.G.B. has forwarded to the T.C. sanction to a loan of £4,722 for extensions at the electricity works.

Chatham.—In regard to the new power station for the Admiralty, now nearing completion, it is of interest to note that for external lighting about 300 arc lamps will be erected, and for internal lighting purposes some 600 to 700 arcs, besides about 18,000 incandescent lamps. Not only will the dockyard be supplied, but also the Naval Barracks, the Marine Barracks, the Gunwharf, and possibly the Royal Naval Hospital. It is also proposed to provide a supply of energy to the powder magazines at Upnor and Chattenden; this will necessitate a cable being laid under the river. Electric motors have been provided all over the yard for operating cranes, &c.

Sixteen months have elapsed since the works of the Kent Electric Power Co., Ltd., at Chatham, were destroyed by fire; the company is now about to open a new generating station on the banks of the Medway, near Strood. Five thousand H.P. of plant is installed in three sets of steam turbo-alternators, giving three-phase energy at 11,000 volts. Sub-stations are erected in various parts of the district to transform the energy down to 400 volts for power, and 230 volts for lighting. The trunk cables between the generating station and the transformers are laid in earthenware conduits (already laid between Frindsbury and Luton Arch, Chatham). It is intended to provide duplicate mains so as to minimise inconvenience should a fault occur at any time.

Chipping Norton.—A public electric lighting scheme has recently been inaugurated, energy being supplied by a 40-H.P. gas driven plant. Eight flame arcs have been erected, and existing gas standards are, we understand, being adapted for electrical incandescent lamps.

Continental Notes.—GERMANY.—The municipality of Allenstein (East Prussia) has decided on the establishment of an electric lighting scheme for the town.

The municipal E.L. undertaking at Mulhouse (Alsace) is about to be extended at an estimated cost of £89,000.

ITALY.—The authorities of the province of Udine have granted a concession for a hydro-electric plant to be put down on the River Ornenco at Montenars, for lighting and power purposes.

A small company has just been formed with a capital of £5,200 to establish an E.L. scheme for the town of Cornelico.

Cotton Mills.—We learn that Messrs. W. Moores and Sons, cotton goods manufacturers, of Dankhill, Bolton, are about to adopt electricity in their mills, and they are about to build another shed to hold 200 looms, bringing their total up to 2,000 looms.

Darlington.—The T.C. has applied to the L.G.B. for a loan of £7,200 for mains, services, meters, switchboard extensions, and mechanical stokers.

Dudley.—The annual accounts of the Corporation's electrical undertaking were issued last week. It shows that the revenue from the sale of energy for public, traction, and private supply, together with that for lamps, &c., amounted to £11,068, compared with £10,707 for the previous 12 months. Of the total receipts, the sum of £4,153 has been absorbed in the repayment of loans and interest thereon, £622 by bank charges, leaving a net profit of £323 on the year. The reserve fund, made up from the profits of previous years, stood on March 31st at £2,000. There was an increase of £360 in revenue, but the gross profit was £71 less than last year. The total capital expenditure in connection with the undertaking up to March 31st last was £81,450.

Fareham.—The U.D.C. has decided to supply energy to two places outside the compulsory area, on a guarantee of an annual consumption to the value of £40 being given.

An alternator and a belt-driven exciter are to be added to the plant.

Huntingdon.—The T.C. has given its assent to an application for a prov. order for E.L. by the Electrical Works Development Co., reserving to the Council the right of safeguarding its interests as regards the area of supply, site of works, maximum charges, street lighting, and terms of purchase.

Ivybridge.—After a long discussion, the U.D.C. has passed a resolution approving of electric lighting for the town.

London.—LAMBETH.—The report of Mr. G. Pearson, the auditor appointed by the B. of T. to examine the accounts of the South London Electric Supply Corporation for the year ended December 31st last, was circulated by the B.C. on Wednesday. The report was as follows:—"I have audited the above accounts for the year 1905, and found them correct. I have to report that the overcharge which I disallowed in the accounts for 1900, of £2,275 to capital for directors' fees has not yet been corrected. The balance-sheet contains unrealisable assets as follows:—(1) Expenses of flotation of company, £33,689; (2) battery of accumulators, £618. The provision for depreciation is still inadequate. I certify that the capital expenditure to December 31st, 1905, amounted to £348,169."

BATTERSEA.—Mains extensions are to be carried out at an estimated cost of £575.

FULHAM.—On August 30th, 1,953 premises were connected to the mains with an equivalent of 97,504 8-C.P. lamps. Twelve months ago the figures were 1,554 premises and 78,033 8-C.P. lamps.

HACKNEY.—Mains extensions are to be carried out at an estimated cost of £403.

CAMBERWELL.—Three ratepayers' associations are working hand-in-hand with a petition against the introduction of the proposed electric lighting scheme. Papers are being signed in numerous parts of the borough, and already thousands have affixed their names to the lists.

Luton.—The T.C. has received from the L.G.B. sanction to a loan of £7,000 for E.L. purposes.

Lynton.—The Lynton and Lynmouth Electric Light Co. has secured the public lighting contract for the district for a period of 14 years, the price being approximately 2d. per unit.

Mansfield Woodhouse.—The U.D.C. has applied to the B. of T. for a year's extension for carrying out the E.L. order.

Middlesbrough.—The T.C. has decided to supply energy to all flat rate consumers as from the end of the present quarter, at 4d. per unit for the first 1,000 units per quarter, and at 3½d. per unit beyond.

New Zealand.—WELLINGTON.—The ratepayers' formal approval of the City Council's proposal to borrow £100,000 for electric lighting, and to enter into competition with the New Zealand Electrical Syndicate in the private lighting of the city, has resulted in the latter instructing its solicitors to notify the Council that it proposes to apply in the Supreme Court for an injunction restraining the Council from carrying out its intention, inasmuch as it contravenes an agreement entered into by the syndicate with the City Council.

Redcar.—The U.D.C. has asked the Cleveland and Durham Electric Power Co. to quote terms for street lighting by electricity.

Ryde.—An Isle of Wight paper recently stated that a cylinder of one of the gas engines at the electricity works burst and that one of the employés had a narrow escape from injury. Supply was maintained on the day of the accident from the battery. Another engine was being overhauled at the time, and in consequence, despite an attempt by the staff to get this set running, the town was without the supply for one night. A new set is also being put down, but is still in the course of erection.

St. Annes-on-Sea.—Below we give a short abstract of the accounts of the electricity department of the U.D.C. for the fourth and fifth years of working:—

Year ended March 31st,	1906.	1905.
Total revenue	£7,913	£7,322
Total working expenses	4,054	3,806
Gross profit	3,859	3,516
Interest received	36	25
Interest charges	1,320	1,187
Sinking fund	1,330	1,167
Depreciation	1,244	187
Balance, applied to rates	—	1,000
Capital expended	£40,435	£38,606
Public lamps	34 arc. 216 N. and inc.	34 arc. 171 N. and inc.
Maximum load in KW.	336 tr., 219 ltg.	400 tr., 179 ltg.
Units sold:—		
Private supply	178,903	137,295
Contract	355,298	373,846
Public lighting	81,850	78,359
Total	616,051	589,500
Average total price obtained per unit	3·08d.	2·98d.
Total working costs per unit	1·57d.	1·56d

It will be seen that the gross profit has increased this year, as compared with 1905. An increase in the total price obtained per unit has accurred, this being accounted for principally by an increased proportion of private lighting. An increase in cost of repairs to mains and cost of collection and accounting, which was formerly charged to another department, explains the slight increase in costs per unit.

St. Helens.—The T.C. has decided to hire out arc lamps, and to repair and maintain them.

South Africa. — JOHANNESBURG. — Messrs. Hubert Davies and Spain are installing an electric light plant for the houses and stables of the Hon. Hugh Wyndham's stud farm at Standerton, where an unusual proportion of the labour is done by electricity.

Standish.—The U.D.C. has appointed a deputation to consult with the town clerk and the electrical engineer of Wigan with reference to obtaining a supply of energy in bulk.

Stirling.—Herewith we give a short analysis of the burgh electricity accounts for the year ended May 15th last, with comparative figures of the previous year:—

Year ended May 15th,	1906.	1905.
Total revenue	£4,674	£4,147
Total working expenditure	2,462	2,242
Gross profit	2,212	1,905
Financial charges	2,410	2,209
Loss on year's working	198	304
Capital expenditure	£39,486	£38,518
Number of public lamps	253	266
Maximum load	228 KW.	201 KW.
Units sold:—		
Private supply	184,846	150,977
Public lighting	101,229	92,008
Total	286,711	243,551
Average total price obtained per unit	3·91d.	4·08d.
Working cost per unit	2·06d.	2·16d.

Swinton and Pendlebury.—The U.D.C. on September 4th sealed the agreement with the Lancashire Electric Power Co. for a supply of energy in bulk. The L.G.B. will now be asked to sanction the loan applied for.

TRAMWAY and RAILWAY NOTES.

Accrington.—The lease of the Accrington tramways expires in April. The system is then, we understand, to be electrified by the Corporation.

The sub-committee appointed to consider a scheme for the electrification of the Accrington tramways has recommended that the Corporation should operate the system direct by its own staff rather than lease it. The estimates are: Construction of new and alteration of existing tramways, £50,800; cost of electrical equipment, £33,300; total, £84,100.

Blackpool.—On the 6th inst. a man was knocked down by an electric tramcar; his legs got under the life-guard, and he was dragged a few yards, his legs being pinned between the front bogie wheels and the brake blocks. The car was raised by means of jacks, but death ensued. At the inquest a verdict of "Accidental death" was recorded.

Continental Notes.—Germany.—The scheme promoted by the Continental Company for Electrical Enterprises, which aims at the construction of a suspended electric railway between Gesundbrunnen, Alexander Platz and Rixdorf, on the same system used at Barmen, has not made any progress from the point of view of the investigation of the plan by the responsible authorities in Berlin. On the other hand, the company's Berlin bureau has utilised the summer for the purpose of making five models on a large scale of the various kinds of constructional supports intended for the railway, and these will be shown to the authorities in order to demonstrate the slight extent to which light and air would be withdrawn from the streets by the building of the railway. As will, perhaps, be remembered, the Municipal Highways Committee adheres to its proposal that the company should construct an experimental line in one of the streets which would later on be used by the suspended railway. The Committee has refused to agree to the company's proposal to construct the trial section at a spot which would permit of comparison with the elevated electric railway, and show the application of all the methods of supporting the suspended structure. It is hoped by the company to overcome all the objections raised on æsthetic grounds by reason of having secured the services of four well-known Berlin artists designing the architectural features of the constructional ironwork and of the railway stations.

Dewsbury.—The T.C. on September 6th decided to apply to the B. of T. for a loan of £9,500 for the electrical equipment of that part of the Dewsbury, Batley and Birstall tramways within the borough. The amount also includes costs in connection with the purchase.

The B. of T. has also been asked to approve of the lease of the tramways to the B.E.T. Co., and an agreement with the National Electric Construction Co. for the construction and leasing of the tramways from Dewsbury to Ossett has been sealed.

Gateshead.—The T.C. has consented to the application of the local tramway company for a further extension of time for completing the tramway to the borough boundary at Wreckenton.

Halifax.—The Mayor last week received a requisition, signed by six Councillors, asking for a special meeting of the Council on the subject of the tramway dispute, and he declined. Of the late tramway employés, 215 handed in their uniforms, and asked for their last instalment of wages.

A mass meeting was held on Sunday last in Savile Park, when a resolution was carried "supporting" the tramway men now on strike. The tactics adopted by the men are not calculated to invoke much sympathy for them. We now understand that the tramway men at Huddersfield have resolved to support the Halifax men by a weekly levy; motormen paying 1s. and conductors 6d. so long as the strike lasts.

The tramway strike continues, but the Corporation has endorsed the action of the Tramways Committee, and is supported by public feeling in the town.

On Monday an attempt was made to settle the strike. A vote by ballot was taken, the result being that only two voted in favour of accepting the terms offered by the Tramways Committee.

Hythe (Kent).—According to their promise, if their tramway Bill received the Royal assent, the National Electric Construction Co. have paid £1,500 to the T.C.

Japan.—The *Daily Telegraph* correspondent at Tokio says that demonstrations and rioting took place last week at Tokio, as a public protest against the raising of tram fares, and resulted in traffic being suspended and trams wrecked. Some of the company's offices were stoned and wrecked.

London.—L.C.C.—At Lambeth last week a motorman was summoned by the police for driving to the common danger. The case arose out of a collision between the car defendant was driving and one in front. He stated that another car was about 50 yards ahead of him, and when he saw a woman hail it he applied the hand-brake, but it failed to act. He then tried sand, but the car did not stop, so he applied the electric brake, but the wheels skidded and his car ran into the car ahead. The woman who was about to step on was thrown down and sustained severe bruises. The magistrate, Mr. Hopkins, said it was eminently a case for a jury, and committed defendant to trial at the South London Sessions, but released him on his own recognisances.

A B. of T. inspection of the electrified lines from Vauxhall to Westminster Bridge and Southwark took place last week.

Seven more L.C.C. motormen were summoned before Mr. Rose, at the Tower Bridge Court, at the end of last week, for exceeding the speed limit. In one instance a car was stated to be travelling at 17 m.p.h. over one section of Westminster Bridge Road, where the speed limit was fixed at 6 m.p.h. The magistrate said when he first dealt with similar cases he imposed a nominal penalty, but there seemed to be a general conspiracy to increase the speed, and he should increase the penalties. In consequence, five of the men were fined 20s. and 2s. costs, and the others 18s. and 2s. costs.

Manchester.—The Parliamentary Committee of the Corporation has refused to grant any facilities for the promotion of an underground railway and tramway scheme.

Mansfield.—On Thursday last week the motormen and conductors in the employ of the Mansfield and District Light Railway Co. handed in their notices to terminate their services on Monday last, the trouble arising out of the issue of a new duty sheet. The company is engaging men from other towns to operate the cars. As at Halifax stone-throwing has been indulged in.

Later reports indicate that riotous behaviour on the part of the inhabitants has taken place, and in a large measure the appeal to boycott the cars seems to have been successful. On Tuesday three persons were fined 10s. each for throwing at car drivers. Public feeling is high against the "imported" men working the cars. The miners at all the pits in the district are stated to be "generously" responding to collections on behalf of the men on strike. So threatening did the crowd become on Monday that the company discontinued running the service.

Through the offices of the Mayor, representatives of the company and the employés met on Tuesday night, but after two hours' discussion the company declined to entertain the men's demands for increased wages or to take back *en bloc* the men who had resigned.

Perth.—It is stated that a proposal has been made by the National Electric Construction Co. to lease the tramway system of the Corporation. If the Council entertains the proposal, the company is prepared to inspect the line, and lay a definite scheme before it for acceptance.

Salford.—A correspondent writing on Tuesday said that arrangements had been made for a meeting to be held at midnight on the 13th inst. by the tramway men of Salford, to consider the attitude of the Tramways Committee of the Salford Corporation in refusing the recent application of the motormen to be placed in the same position as their fellows in Manchester, and granting the conductors a ½d. per hour advance in wages.

Wemyss and District.—The cars on the Wemyss and District Tramways system have been in operation since August 25th, but the formal inauguration took place on Saturday last, when Lady Eva Wemyss entertained a large and representative company to luncheon at Wemyss Castle. Since the opening, the traffic has exceeded expectations, and it is realised that, while the nine cars originally acquired may be sufficient for ordinary traffic, a considerable addition will have to be made to the rolling stock. The line is nearly eight miles long, and starts at Durie Street, Leven, joining the Kirkcaldy Corporation's system at Gallowtown. For something like three-fourths of the distance the line is constructed on land belonging to the promoter, Mr. Wemyss.

Woking-Bagshot.—"In October the construction of a light railway to connect Woking and Bagshot stations of the London and South-Western Railway is to be commenced. Electricity, conducted by the overhead system, is to be the motive-power, and the line at Woking is to join the L. & S.W. Railway goods sidings. The districts of Horsell, Chobham, and Windlesham will be touched by the new railway, which is to cost £150,000. Messrs. Johnson & Phillips are the engineers."—*Westminster Gazette.*

TELEGRAPH and TELEPHONE NOTES.

Derelict Wires.—Our esteemed contemporary, the *Globe*, referring to the London Corporation's account of the overhead wires in the City, says that since 1899, when the Corporation undertook the work of supervision, 22½ miles of derelict wires have been removed; all owners of overhead wires are now required to identify them by having a perforated zinc label of approved pattern attached. During 1905 the number of private owners of lines increased to 131, the number of companies remaining at 18. Both have considerably added to their number of spans during the last 12 months, and these now total about 699,300 spans crossing public thoroughfares, as compared with 682,000 spans last year and 260,000 spans in 1899. There has been a net increase of nearly 820 miles of National Telephone Co.'s wires.

Grimsby.—The Highways Committee of the Corporation has considered and rejected an application of the National Telephone Co. for leave to lay telephone wires underground. The idea as implied by the Mayor's remarks, appears to be that, because the present service is unsatisfactory, the company shall not be allowed to improve it! Such is the wisdom of Bumble.

Glasgow.—On Tuesday last the Post Office acquired possession of the Corporation Telephone Service, for which, with loose tools and stores, £308,066 was paid. What the total cost will be by the time the service has been made efficient remains to be seen; it is admitted that much of the plant is obsolete. The employés have been taken into the service of the Post Office, but the question of their future status remains open for consideration. The Postmaster-General foreshadows an early revision of the rates charged—evidently intending to raise them to a remunerative level.

Holland.—The *Journal Télégraphique* publishes *in extenso* a Royal Decree providing for a 10 cents rate per word and a minimum of one florin for telegrams from telegraph stations on the coast in wireless communication with ships at sea or one another. The Minister of Public Works may, however, authorise the collection of an additional "maritime" rate of 10 cents per word for wireless stations on ships. Rates are payable by the senders of messages to ships at sea and by the receiver in the case of messages from ship to shore. If, however, the captains or commanders of ships guarantee the payment, the sender may prepay messages. The station at Scheveningen-Haven is the chief one, and all work must be sent through it. It is open day and night. Records are to be kept on a prescribed form of all particulars of working, messages sent, received and *intercepted*. When the boats leave British territorial waters a preliminary signal is to be sent to the station for the purpose of assuring proper working. When the ships enter British territorial waters a signal is to be given to cease transmission. Signals or messages from ships in distress are to be given priority over all other telegrams, and transmission of other work must be suspended until these signals are answered.

New Cables.—The *Correspondencia de Espana*, in a recent issue, makes the announcement that the Eastern and Western Telegraph Companies have conjointly, through their Madrid representative, Don Salvator Sabator Sanchis, made proposals to the Spanish Government for duplicating the present telegraph communications between Spain and the Canary Islands. The aforesaid companies offer to lay, free of cost, a new cable between Cadiz and the island of Tenerife, and, when completed, will hand it over to the Spanish Government. The cable will become the absolute property of the said Government; it will be worked by the Spanish Telegraph Administration, and the traffic and revenues will accrue to the Government. The said companies will further enter into an agreement with the Spanish Government for the repair and maintenance of both the main and inter-insular sections. In return, the Spanish Government will grant to the said companies the exclusive rights, for a term of years, for laying cables between the Canary Islands, the Spanish possessions in Africa and the adjacent islands on the one hand, and any foreign territory on the other.

The ss. *François Arago* has completed the laying of a cable between Bourbon and Mauritius.

The French Administration also announces the opening of the Saigon-Pontianak cable. Service with the Island Poulo-Condore will be opened later.

Newcastle-on-Tyne.—Additional trunk and junction telephone lines are being constructed between Newcastle-on-Tyne and London, Liverpool, Leeds, and many neighbouring towns, and the Post Office telephone switchboard at Newcastle is being modernised.

Norwich.—New trunk telephone lines are to be provided from Norwich to London, Cambridge, Ipswich and Yarmouth, while Thetford is to be removed from the London line and given a separate line to Norwich. The existing trunk line between Lowestoft and London is to be worked in future between Norwich and London.

Stealing Telegraph Wires.—Last week four persons concerned in the theft of telegraph wires on the Great Eastern Railway were committed for trial.

Telegrams for India.—The Indian mails now being made up at Dover on Friday night, the Post Office has made arrangements whereby late communications destined for India may be telegraphed from any part of the kingdom to Dover and forwarded from there as letters by mail. The telegrams must be marked "Post, Dover," in addition to the usual address, and must arrive before 10 p.m.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1903	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz	July 12, 1906	
Bolamo-Bissao	July 24, 1906	
Curacao-La Guayra / Curacao-Coro (Closed)	Jan. 11, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	
Bagdad-Bassorah	July 17, 1906	

Wireless Torpedoes.—Senor Leonardo Torres Quevedo, the inventor of the "Telekino," an electrical apparatus for directing from land the movements of vessels at sea, who is now in Bilbao, says the *Daily Telegraph*, was asked by King Alfonso to make experiments with his invention from the *Giralda*. The Queen told the inventor what movements she wished the boat to make, and he carried out her instructions, causing the craft to turn or stop with admirable facility. Senor Torres Quevedo is assisted in his experiments by a State subvention. The boat works automatically, and carries no crew, and if the transmitting apparatus broke down the vessel would continue its course without direction. The inventor has, therefore, added another automatic arrangement, which comes into action as soon as the Hertzian current ceases and causes the boat to stop. The correspondent further states that he has seen it directing the movements of tricycles, carriages and boats, which obey the wishes of the inventor with minute precision. The inventor believes he has solved the problem of directing torpedoes and submersibles from land. This is pleasant reading for our Navy—but we lack the inventor's confidence in his apparatus.

Fire.—On Wednesday a serious fire took place in Holborn, destroying a large number of overhead telephone wires and cables. More than 300 subscribers were cut off. The National Telephone Co. took vigorous steps to repair the damage with the utmost dispatch.

CONTRACTS OPEN and CLOSED.

OPEN.

Blackrock (Co. Dublin). — September 22nd. The Main Drainage Board wants tenders for an electric power installation. See "Official Notices" September 7th.

Dublin.—September 19th. The City Technical Education Committee wants tenders for the electric lighting of the Technical Schools, Lower Kevin Street. Specification, with general conditions and form of tender, may be inspected at the office of the City Electrical Engineer, Fleet Street, Dublin. 10s. 6d. for each specification.

Edinburgh.—September 20th. The School Board invites estimates for an electric light installation at Gilmore Place School. Specifications, &c., may be obtained at the office of Mr. Carfrae, Architect, 3, Queen Street.

Gillingham.—September 24th. Coal for the Corporation generating station. See "Official Notices" to-day.

Handsworth.—September 15th. Electric wiring for the Council's new schools. See "Official Notices" August 10th.

Limerick.—October 2nd. Gas plant, gas engine and dynamo, switchboard extensions and cables for the Corporation Electricity Department. See "Official Notices" to-day.

Mersey Railway.—The directors invite tenders for the supply of oil, grease, ironmongery, waste, castings, asbestos and india-rubber goods, chemicals, brake blocks, firebricks, electrical sundries, and other general stores, for 12 months. Forms of tender may be had on application to the secretary.

Merthyr Tydfil.—September 20th. Stores for the Hill's Plymouth Co., Ltd., for 12 months, including india-rubber, asbestos electrical appliances, &c.

Southport.—September 29th. Electric motors, gas engines, pumps, &c., for the Corporation. See "Official Notices" to-day.

Spain.—September 23rd. The municipal authorities of Tortella (Gerona province) are inviting tenders until the 23rd inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Tortella (Gerona).

CLOSED.

Brandon.—The U.D.C. has accepted the tender of Mr. W. Fletcher, of Newcastle, for the supply of poles, cables and lamps, for electric lighting at Sleetburn and Waterhouses.

Halifax.—The T.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for the supply of cable for two three-wire feeders, at £1,283.

London.—The managers of the West London District Schools have accepted the tender of Messrs. Johnson & Phillips, Ltd., for two steam dynamos, switchboard and cables.

Battersea.—The B.C. has accepted the following tender in connection with the extensions of plant at the central station and with the Nine Elms lighting scheme:—W. T. Glover & Co., Ltd., cable, £168.

Hackney.—The Electricity Committee, in a report circulated on Monday, stated that it had received during the vacation the following tenders for the electric lighting of the Town Hall:—

Bromley, Batstone & Kirk	£400	G. E. Taylor & Co.	£291
Drake & Gorham, Ltd.	309	Marryat & Place	274
Barlow Bros. & Co.	299	F. A. Glover & Co., Ltd.	241
Smith & Co.	294	Tyler & Freeman	240
Jeboult Bros.	294	J. H. Golding (accepted)	168

Manchester.—Messrs. A. Reyrolle & Co., Ltd., have been instructed by the Committee to supply motor starters during 1906-7.

Neath.—The R.D.C. has placed an order with Messrs. Johnson & Phillips, Ltd., for the supply and laying of extension distributor cables and wires and erecting all street lanterns.

South Shields.—The Tramways Committee recommended the acceptance of the British Westinghouse Co.'s tender, at £5,325, for the supply of 10 additional cars.

Stalybridge.—The Joint Tramways and Electricity Board has accepted the tender of Messrs. W. T. Glover & Co., Ltd., for the supply of cable.

Messrs. Bruce Peebles & Co., Ltd., have received an order, through Messrs. Willans & Robinson, for one 2,000-kw. 6,000-volt 40-cycle turbo-alternator for the Stalybridge, Hyde, Mossley and Dukinfield tramways.

Sydney (Australia).—The Municipality of Sydney (Australia) has decided to install two 2,000-kw. steam turbine sets, and the order for the turbines and the necessary condensing plant has been placed in the hands of Messrs. Willans & Robinson, Ltd., of Rugby, who are manufacturing the plant to the order of Messrs. Dick, Kerr & Co., the main contractors. The turbines are being arranged for driving the Dick, Kerr turbine type of alternator.

Torquay.—The T.C. has accepted the tender of Mr. Tizzard, of Torquay, for the supply of electrical fittings for the Free Library, at £105 10s.

FORTHCOMING EVENTS.

Saturday, September 15th.—Engineering and Machinery Exhibition opens at Olympia, London, W.

September 19th, 20th and 21st.—Municipal Tramways Association. Fifth Annual Conference at Leeds. (See "Notes" to-day.)

MANUFACTURERS SELLING DIRECT TO CONSUMERS.

The following letter from the Electrical Co. came to hand too late for inclusion in our "Correspondence" columns. We print with it a letter on the same subject from the Northern Electrical Co.:—

Our attention has been drawn to the correspondence under the above heading which has appeared in your paper, and particularly in your issues of August 3rd and 31st last, in which it is stated that the Electrical Co. have supplied a large drapery establishment in Doncaster with Nernst lamps, whilst not calling on the electrical firms of the district.

We have investigated the matter, and beg to give the statement a distinct and emphatic denial. The drapery establishment, whose name we have obtained from your correspondent, is not, and never has been, a customer of our firm. We have accordingly placed the matter in our solicitors' hands, with a view of obtaining a withdrawal and apology from your correspondent.

We would ask you to insert this letter by way of correction in your next issue, so as to disassociate our firm from the practices referred to, to which they have never been a party, and would also be glad if you would state the full name of the correspondent who wrote on this subject, signing himself "Transgressor."

The Electrical Co., Ltd.

London, W.C., *September 12th*, 1906.

In your issue of August 31st we made certain complaints about the Electrical Co. dealing direct with consumers. We find that the people actually transacting the business are the "A.E.G."

If the "A.E.G." and the Electrical Co. are not the same people we beg to offer the latter our sincere apologies.

The Northern Electrical Co.

per J. P. C.

Doncaster, *September 8th*, 1906.

NOTES.

Popular Science.—One of our valued lay contemporaries—the *Morning Post* this time—has broken out in a fresh place. It informs us that "Very slight currents are employed in telephony. The electromotive force sufficient to lift an ounce one foot high would operate a telephone for 15,000 years. Consequently great care must be taken to prevent leakage of these minute and delicate currents, and to this end thick wires are used. The line between London and Glasgow contains eight hundred pounds of copper per circuit for every mile it passes over. Thus a subscriber talking between the two cities has the exclusive use of more than 130 tons of copper."

Lucky man! We fear he does not fully appreciate his good fortune. We should like a few lumps of that energetic electromotive force. Though we never saw an ounce a foot high, we have seen a pound 30 ft. in circumference—formerly used for interning stray donkeys—and we think it is a pity it has fallen into disuse.

Our informant goes on:—"The electrical transmission of power, so far as the upper limits are concerned, still awaits better means of insulation. It is not feasible to transmit voltages of higher than 50,000 or 60,000. That is quite high enough for the purpose of transmission when the distances are not very far; but it imposes a limit to the distances at which water power can be used."

Clearly he has forgotten that if thick wires are used, leakage will be prevented!

In another, but less eminent, paper we read that certain persons find their legs give way when they enter electric tramcars, and they attribute this failing to the "static electricity at large." Several people dare not use the cars for this reason. We never heard it called static electricity before—perhaps it is XX-rays.

Voltax—A New Insulator.—Our esteemed contemporary the *Génie Civil*, quoting from an American paper, describes a new insulating material known as "Voltax," a heavy hydrocarbon, which has a higher melting point than the similar substances generally used. The process is worked by the Electric Cable Co., of Bridgeport, U.S.A., who insulate wires with cotton tape impregnated with the material (of which the exact composition is secret); the tape is wound on in layers to a thickness depending upon the pressure to be resisted, after which, says the *Génie Civil*, the wires are cabled, and the cable thus formed is finally covered with one or more layers of jute to prevent external damage. Wires insulated in this way with a single tape, tested at the Electrical Testing Laboratories, New York, broke down with a pressure of 2,500 volts alternating, but some stood pressures up to 70,000 volts. With two windings, the breakdown pressure was 4,000 to 10,000 volts, and a wire covered with six windings, after steeping in salt water for 72 hours, withstood the test until 23,000 volts was reached. The wires were then traversed by heavy currents, up to 200 amperes (the gauge of the wire is not stated); at this current the insulating material began to melt. Again tested after this, the wires with one covering stood up to 2,000 volts, and those with four up to 16,000 volts. Laminæ of the insulator "75 mm." (this is obviously a misprint for ·75 mm.) in thickness were pierced at 20,000 to 25,000 volts; those of "105 mm." (evidently 1·05) at 30,000 volts. Their resistance was too high to be measured even approximately. The substance can be used for filling wooden conduits in which bare wires are laid on porcelain insulators.

Railway Motor-Coaches in Germany.—The Prussian Minister for Railways has required the State railway administrations to submit a report on the subject of a petition presented by the Wiesbaden Chamber of Commerce, asking for the introduction of motor-coaches and motor-trains on the Prussian railways. It appears from investigations made by the Chamber, that electric accumulator coaches and one steam motor-coach are in experimental use on branch lines of the railways in the Palatinate, although the battery vehicles were supposed to have been abandoned long ago. The Chamber, however, finds that they are still in service, and that they fulfil the object of intervening in the long intervals existing between the running of the trains, and of transporting school children, notwithstanding that they possess both technical and economic defects. In Baden several electric battery coaches are also in operation, although, in some cases, the increase in the traffic has necessitated the substitution of ordinary steam trains. The demand for motor-coaches in Bavaria has also become large, and trials are now being made in Upper Bavaria; motor-coaches are likewise being worked in Switzerland on the section Baar-Zug-Scham-Rothkreuz. The Wiesbaden Chamber of Commerce, in drawing attention to these instances, suggests that similar experiments should be made on the Prussian railways, and the question is at present under the consideration of the railway officials.

Cheap Electric Wiring.—At the Royal Cornwall Polytechnic Exhibition, at Falmouth, on 6th inst., Mr. C. E. Algar, of Newport, read a paper on artificial lighting. He, among other things, emphasised the advantages of electricity for interior lighting, and later remarked that a serious problem facing electrical engineers was the large cost of the consumers' installations as compared to the similar installation of gas lighting. The solution had been found on the Continent, where installations were made at probably one-third of the cost. Instead of wires of an expensive make enclosed in casing of wood or steel, wires were being often used of a very much cheaper grade and were carried on the face of the walls mounted on tiny insulators, which were not found objectionable in appearance.

What is a Prime Mover?—A Glasgow firm sent out an electric motor to Ceylon, describing it as a "prime mover." Under the Customs tariff in Ceylon, steam, gas, and oil engines are admitted to Ceylon free of duty as "prime movers." But the Customs authorities declined to recognise the motor as such, on the ground that it simply used current supplied by cable from the power works. The consignor paid the duty under protest, and asked what was the difference between a gas engine using gas conveyed to it through pipes, and a motor using electricity conveyed to it through cables. The Customs authorities replied that steam, oil, and gas engines generated power, but that an electric motor was only on a par with a water wheel. The Glasgow Chamber of Commerce is to take up the question. We cannot agree that an electric motor comes under this head, but, on the other hand, a water wheel certainly does.

Educational Notes.—Northampton Institute.—In view of the increasing work of the Institute and the inefficiency of the accommodation, notwithstanding the large size of the building, the Governing Body has, for the coming session, taken the rooms of the British Horological Institute in Northampton Square. The work of the Technical Optics Department will be conducted in this building. Some of the rooms thus vacated by the removal of this department have been equipped during the vacation for an intermediate electrical engineering laboratory. Another of the rooms made vacant is to be devoted to an extension of the junior laboratory, and likewise another to a much-needed extension of the senior electrical testing laboratory. An extension of the instrument workshop, which has also suffered from overcrowding, has been carried out. In the two last cases the want of accommodation has led to the refusal to enrol late-coming students in the past, but no such refusals will, it is hoped, be necessary during the coming session. The classes of the day courses commence on Monday, October 1st, and those of the evening courses on Monday, September 24th. Enrolments for the latter have already commenced. The head of the Electrical Engineering and Applied Physics Department is Dr. R. Mullineux Walmsley, who is also the principal of the Institute. The associate head of the department is Dr. C. V. Drysdale, and Mr. H. M. Hobart is lecturer in electrical engineering design.

Electric Shock Fatality.—Enoch Archer, a workman employed by the Darlington Corporation, was, on Thursday last week, repairing an overhead tramway wire, when he received an electric shock which caused him to fall 18 ft. to the ground. His head was injured, and he died immediately. It is said that he was not wearing rubber gloves as he should have done at the time, and that instead of using a tower ladder he was on an ordinary ladder.

At the inquest held on 7th inst., Mr. F. W. Hewitt, assistant manager of the electricity department, gave evidence, and said the deceased was a skilled workman. Noticing something wrong with the wires, he at once set about repairing the damage without the proper appliances, and without giving notice to the officials. Witness examined the place after the accident, and found that the deceased had been attempting to repair a switch. The voltage at the time of the accident was 506, which would not be fatal, but would give a serious shock on a wet day.

Samuel Prince Goldsmith, inspector on the tramway system, said that at 12.30 he noticed that the switch was out of order, and he told Archer about it. The latter borrowed a ladder from the telephone office and witness helped him to place the ladder in position. Deceased had ascended and loosened some part of the switch when witness saw a flash, and Archer fell backwards to the ground, 18 ft. below, striking the setts with his head. He had intended giving notice to the man at the depôt after the dinner hour that the switch was wrong, but Archer said he could put it right.

The jury returned a verdict of "Accidental death."

A Minister of Commerce.—At the meeting of the Associated Chambers of Commerce on Tuesday, Mr. Stanley Machin (London) proposed a resolution regretting that it had not been possible during the present session to give effect to the expressed desire of the Chambers of Commerce, that a Ministry of Commerce should be established with a *status* equal to that accorded to other departments of the State, and urging upon the Government the great importance of early action being taken with this object. According to the *Times* report, he said they wanted a Ministry of Commerce which was identified with all the commercial projects of the country, and they had a right to ask that an advisory committee should be appointed representing the leading industries of the country, so that Government action should not be taken until trading questions had been adequately discussed. Our position was being violently attacked by our great commercial opponents, America and Germany, and we had to put our house in order and see that we were equipped with weapons at least as good as those on the other side. It was hoped that when this Ministry of Commerce was appointed, its Parliamentary head would be one who had had commercial experience and possessed the thorough confidence of the commercial men of the country. Mr. E. Parkes, M.P., in seconding the resolution, said that there was a great feeling in the country in favour of trade's being put upon a higher and more important basis than hitherto. He recognised the thorough and energetic manner in which Mr. Lloyd-George had tackled questions of trade, but he urged the importance of making the President of the Board of Trade a principal Secretary of State. The motion was passed.

Amendment of Patent.—Mr. W. P. Thompson is applying for leave to amend Patent No. 18,814 of 1905 for "Electric Incandescent Lamp with filament of Metallic Tungsten." See our "Official Notices" to-day.

Water-Power in Sweden.—At the recent technical congress, held at Norrkoping, Lieut. Sven Lubeck, submitted a paper dealing with the water-power of Sweden and the neighbouring countries. The author estimated the available water-power in Sweden at 10,000,000 H.P., that of Norway at 28,000,000 H.P. and that of Finland at 4,000,000 H.P. It would, however, only be possible to utilise a small portion of the power in these three northern countries on account of the fact that many of the lakes, rapids and waterfalls are located in unpopulated and remote regions. According to Lieut. Lubeck, Sweden is able to use her water-power to a greater extent than Norway—namely, up to 2,000,000 H.P. On the other hand, Norway could utilise 1,500,000 H.P. and Finland only 300,000 H.P. The Swedish water-power could be employed specially for the purposes of mining, the smelting of metallic ores, and the working of chemical factories and paper mills. By means of the utilisation of water-power the demand for foreign coal in Sweden would become considerably less, and the country's commercial balance would change. Indeed, it is calculated that the imports into Sweden would decline by over £3,296,000 per annum simultaneously with an increase of nearly £7,000,000 in the exports. The production of saltpetre electrically would reduce the imports of artificial manures. The Swedish Government, which owns 12 per cent. of the water-power in the country, has purchased the Trollhatte Falls, and provided £270,000 for the acquisition of other sources of water-power.

Wages at Portsmouth Dockyard.—The *Times* says that the Admiralty have granted increased pay, varying from 6d. to 2s. a week, to the mechanics and skilled labourers employed in the constructive, engineering, and electrical departments of Portsmouth Dockyard, to date from April 2nd, 1906.

Hayes v. Electrical Bleaching Co.—At the Chancery Court, Liverpool, on Tuesday (11th) Mr. Talbot moved for the plaintiff and for the Manchester and Liverpool District Banking Co., in the action of Hayes *v.* the Electrical Bleaching Co., carrying on business in Manchester, for a sale of the undertaking and assets charged in debentures issued by the company. The total losses of the company were stated to be £10,526. The liability to debenture-holders for principal and interest was not less than £14,000, and the indebtedness to the bank was £14,000; to loan holders £4,231, and to trade creditors £3,252. The property was directed to be sold by private tender, public auction or otherwise, with the approbation of the Registrar, and the receiver and manager was authorised to borrow £500 to carry on the business pending the sale.

More Admiralty Electricians Afloat.—The *Times* says that in consequence of the development of electrical apparatus in ships, the Admiralty have decided to increase the number of electricians borne, a reduction of able seamen corresponding to the additional numbers of electricians being made in each case.

Appointments Vacant.—Electrician for County Asylum, Prestwich (35s.); junior engineer for Erith electricity works (27s. 6d.); junior shift engineer for the North Wales Power and Traction Co. (£85); second assistant electrical engineer for Southern Nigeria (£300); assistant inspector of scientific supplies for the India Store Department, Lambeth (£200). See our "Official Notices" for particulars.

Municipal Tramways Association.—The Leeds Meeting.—The annual convention of this Association is to be opened next week at Leeds, with Mr. J. B. Hamilton, the Corporation tramways manager of that city, as president. On Wednesday, 19th inst., the Lord Mayor will welcome the visitors, and at night the Corporation will entertain them to dinner. In addition to the usual interesting excursions, visits to works, a reception, and so on, a number of papers are to be discussed as follows:—

"Depreciation and Renewal Funds in Relation to Tramway Undertakings." By Mr. G. W. Holford, general manager, Salford Corporation Tramways.

"Municipal Tramway Operation: Some Points of a Committee's Policy." By Mr. R. A. Smithson, member of the Leeds Tramways Committee.

"Car Brakes." By Mr. Henry Mozley, general manager, Burnley Corporation Tramways.

"Tramway Track Work." By Mr. R. C. Bullough, general manager, Colchester Corporation Tramways.

It will be remembered that the several tramways associations have for some time past had a scheme for amalgamation under consideration. The *Yorkshire Daily Observer*, however, makes the following observations on this point:—"Discussion has taken place recently respecting a proposal to broaden the base of the association by admitting representatives of private tramway companies to membership. This question is likely to arise at the Leeds conference, and it is anticipated that a decision will be arrived at which will result in the proposed extension of scope."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Engineers.—A proposal is to be laid before the Edinburgh Town Council for an increase of the salaries

of the electrical men in the city employment. The chief assistant engineer, who began in 1895 with a salary of £150, has had his salary increased on various occasions since then, and has now £375, which it is recommended should be raised to £400. The superintendent of mains was appointed five years ago at £250, and his present salary is £300 a year. It is proposed to give him £350. The first assistant to the superintendent of mains, who has £190, is recommended for an additional £20; and the second assistant, with £160, is recommended for £20 more. To the salary of £220 a year paid to the resident engineer's clerical assistant, it is proposed to add £30.

Mr. A. Zoller, shift engineer to the Fulham electricity undertaking, has resigned.

Upon the occasion of his leaving to take up an appointment at Fulham electricity works, Mr. E. M. HAYWARD, senior shift engineer at Croydon, was on 6th inst. made the recipient of a solid silver cigarette case and match-box from the members of the staff.

A Committee recommends the South Shields T.C. to increase the salary of the borough electrical engineer from £500 to £550, rising by annual increments of £50 to £700.

The Nelson T.C. last week adopted recommendations of the Electricity Committee appointing Mr. DACRE HELME, of Nelson, as electrical engineer and tramway manager (£150); Mr. G. F. NAYLOR succeeds Mr. Helme as chief assistant, and Mr. WILLIAM HARTLEY becomes mains superintendent in the place of Mr. Naylor.

The marriage of Mr. C. J. SHUTTLEWORTH, sub-station superintendent of the Hull Corporation, to Florence, second daughter of Mr. J. W. Kereham, locomotive department G.C. Railway, was solemnised at Grimsby on the 4th inst.

With reference to the notice which appeared in our last issue regarding Todmorden, Mr. HOLLAND asks us to contradict this statement, as no appointments have yet been made to his knowledge.

Mr. C. S. COLLISON has resigned the post of switchboard attendant at the Corporation Electricity Works, Loughborough, in order to take up a position in charge of the electric light and power plant at the General Post Office, Leicester, from 3rd inst.

Stockport T.C. has granted £50 to the acting electrical engineer in consideration of extra services rendered in connection with the moving of the tramways switchboard, &c.

The employés of the Norwich Corporation electricity department on Friday presented an oak secretaire bookcase to Mr. GEO. WILSON, chief clerk at the generating station, on his marriage.

Mr. A. A. DAY, of Bolton, has our congratulations on securing the appointment to succeed Mr. J. F. C. Snell in the city electrical engineership at Sunderland. The Electricity Committee made the selection on Monday night, Mr. Day receiving 11 votes and Mr. Taite 5 votes. Mr. Faraday Proctor had withdrawn his application prior to the final selection.

General.—Our Canadian correspondent writes:—"Mr. P. W. SOTHMANN, late consulting engineer of the city of New York, has been appointed chief engineer of the Hydro-Electric Power Commission of Ontario, and enters upon his new duties on September 1st. Mr. Sothmann is a native of Denmark, and graduated at the Institute of Technology at Charlottenberg, Germany, in 1891. Although only 36 years of age, Mr. Sothmann has had a wide experience. He has been constructing and managing engineer for various water-power and steam developments in Germany, Russia and South Africa for the Siemens and Halske Co., and for seven years was manager and engineer for the large distributing company of Strassburg, Germany. Since 1905 Mr. Sothmann has been in New York. Mr. Sothmann's duties as chief engineer of the Hydro-Electric Power Commission will be to superintend the estimating, constructing and managing on behalf of such municipalities as may apply to the Commission for power under the recently passed Act. There were over 100 applicants for the position."

The election is announced of Mr. WILLIAM B. BRYAN, chief engineer to the Metropolitan Water Board, as President of the Junior Institution of Engineers for the ensuing session, in succession to Mr. Dugald Clerk.

Amongst recent arrivals from the States are Mr. and Mrs. GEORGE J. KOBUSCH, of St. Louis, Mo., who have just come across on the *Lucania*. Mr. Kobusch is the President of the St. Louis Car Co., and several other big concerns. This is his first visit to Europe, and the journey is in the nature of a pleasure trip.

Mr. G. E. SANDERS, A.M.I.E.E., electrical inspector to the Frontier Fire Insurance Association, has opened an office at East London, Cape Colony, where he will practice as a consulting electrical engineer.

Obituary.—With reference to the death of Prof. S. JOYCE, to which we made reference in our last issue, a correspondent writes:—"Prof. Joyce, who had been unwell for some weeks, was attacked by enteric fever, which is very prevalent in Bombay, and this was followed by complications which proved fatal. At the time of his death Prof. Joyce occupied the Chair of Electrical Engineering at the Victoria Jubilee Technical Institute. He was also associated with journalistic enterprise in Bombay, being one of the founders and proprietors of the *Indian Electrical, Mechanical and Textile News*. His career in England is well known, and he was author of an electrical text-book entitled 'Examples in Electrical Engineering,' a work much appreciated by teachers and students."

NOTES ON GAS ENGINES.

[COMMUNICATED.]

So much is heard of the irregularity of gas engines, that the points which determine such irregularity ought to be fully comprehended in order that correct conclusions may be arrived at.

Taking the ordinary or Otto cycle, more properly styled the Beau de Rochas cycle, the common variety of single-acting gas engine at its best only possesses one working stroke in four. The crank must pass through 720° of arc for each propulsion stroke, and the fly-wheel must have a sufficient store of energy to enable it to maintain the desired speed between one working stroke and the next. Let it be assumed that the normal speed is 200 r.p.m., and that the limit of speed is two revs. on either side of the normal. Then the engine will run at 202 r.p.m., and in the course of three strokes will slow to 198 r.p.m. It will decelerate at the rate of $1\frac{1}{3}$ revolution per stroke, so that the retardation will be regular and imperceptible. Since, however, the working stroke is required to put up the speed by 4 r.p.m., it follows that during this one stroke the acceleration will be 4 r.p.m in one stroke, or three times more severe than the rate of loss of speed during the idle strokes.

If governing is done on the hit-and-miss system it may require four revolutions of the crank to slow down the engine to the gas-feed position of the governor; but the speeding up will be as rapid as before, or seven times more rapid than the previous deceleration.

Now the heavier the fly-wheel, the more delicately can the governor be set, and the more closely will the minimum speed approach the maximum speed. Obviously, therefore, fly-wheel weight is the one thing needful to produce any desired narrowness of limits of angular velocity.

When an engine is made double-acting, it may be made of one-half the cylinder area for equal power. Indeed, it may have less than half the area if friction be duly allowed for. Consequently the working strokes will be doubled in a given time, and the impulses will be halved in intensity. Since there will be a working stroke for each revolution, the rate of acceleration during the working stroke will be the same as the deceleration during the idle stroke.

Speed fluctuations will be doubled in frequency, halved in intensity and trebled in regularity of the ratio of acceleration to deceleration. There will still remain the fault of a greater irregularity for partially loaded engines—a fault only to be got over by abolishing hit-and-miss governing in favour of graduated charges, which, if less efficient economically, have the advantage in greater regularity of turning effort.

Regularity is again doubled when the engine is arranged both double-acting and with an explosion every stroke, as when the engine is worked on the Clerk cycle, with separate charging cylinders or pumps. With such an engine the regular turning effect only falls short of that of the steam engine if its indicator card shows it to be so, and it can hardly be said that gas engine cards with poor gas show anything of this.

If, however, the Clerk cycle be not employed, then it becomes necessary to employ two cylinders to attain the same result as is attained by one cylinder of a steam engine; or, failing this, the fly-wheel energy must be increased either by speed or by mass action in order to compensate for the difference.

The bad character which was earned by the early gas engines was very largely due to the use of too powerful a gas. Most of the illuminating gas supplies possess a calorific capacity of about 650 B.TH.U. per cb. ft. In addition, they were almost wholly hydrogen or of fairly light hydro-carbon, and were, therefore, very rapid burners. They burned explosively, and were not suitable at all for large engines, because such gas is very liable to pre-ignition, and this fault rapidly grows to be a danger with the increase of size of the cylinder in which it is exploded. A modern power gas has a calorific capacity of perhaps 120 B.TH.U. per cb. ft. Blast furnace gas, which is the prototype of the modern power gas, has, indeed, often less than 100 B.TH.U. capacity. By "power" gas is to be understood a gas, the combustible part of which is chiefly carbonic oxide. This

gas is slow to burn, and a small percentage of hydrogen is allowed to quicken its combustion. Its combustion may be so dilatory that maximum pressure is only attained after the piston has travelled well away from the dead point. Engines worked by such gas show no shocks, but work with the same quiet as steam engines, and do not require more than the above described desiderata to be of equal turning and cyclic regularity.

If, therefore, the steam engine can be made to run alternators in parallel, it should be equally possible to do the same with a modern gas engine. The bad character given to the gas engine by highly calorific gas has, in fact, been allowed too long to influence men's minds. What physical or mechanical or dynamical reasons can now be advanced against any proposition to drive alternators by modern gas engines with "power" gas of the recognised composition, that is, about one-fourth of CO to one-twentieth of hydrogen, the remainder being merely diluent and chiefly nitrogen?

It has been previously suggested in these columns that there is a disadvantage in too sudden a complete combustion of the charge in a gas engine cylinder, because such early explosion merely puts a maximum pressure upon the rotating shaft and crank-pin, which becomes a brake on the engine when the crank stands at no angle of effort. Later explosion behind an already moving piston more directly converts the heat of combustion into work and turns the crank. The disappearance of heat as work, moreover, reduces the quantity of heat sent into the water jacket.

In the steam engine there is an objection to late admission to be found in the fact that there is not then a sufficient pressure to start the piston in motion from the dead point, and it has consequently to be pulled along by the rods from the crank-pin. But in a gas engine there is so much initial compression that this suffices for the starting of the piston, and it is sound practice not to encourage prompt explosion on the dead point, nor to aim at producing an indicator card after the approved type of the best steam engine cards.

The writer is of opinion, therefore, that if the arrangement and conditions of the large gas engine with power gas be carefully thought over and worked out, no serious objection can be brought forward of greater weight than may be brought against the steam engine in respect of the variations in velocity, that would militate against the successful driving of alternators.

There is one much debated difficulty to be avoided, namely, too great a weight of fly-wheel, for this introduces an inertia trouble in synchronising, and leads one to avoid the heavy fly-wheel and to obtain a sufficient regularity of turning moment by means of a numerical sufficiency of cylinders.

It has been pointed out that alternators could be run in parallel when rope driven, the elasticity of the ropes affording correctness of phase by synchronising torque, which could not be obtained where the same machines were direct driven and there was inelastic inertia in the combination. The question for gas engine builders to-day is—How best to compromise the various conflicting elements of the problem so as to secure the best results.

ELECTRICITY SUPPLY ACCOUNTS.

Cardiff Municipal Electricity Supply.

The result of the last completed year's working shows the department to be moving on steadily. The output increased some 16 per cent., and with a load factor of 17½ per cent. the working costs more than maintained their favourable position in 1905.

On the year a gross profit of £14,740 was earned, as compared with £12,517 in the previous year; the financial charges, however, were on a heavier scale and reduced the year's surplus to £1,608. The recent adoption of alternative tariffs is expected to affect next year's income, although this can hardly fail to help the undertaking eventually.

During the year £9,158 was paid to the tramways department for some 2,200,000 units (D.C.); this amount was allocated as to £3,664 to generation costs and the balance to loan charges.

The prices charged are:—Private lighting, 7d. and 2d. maximum demand system, or 3½d. flat rate; power, 4d. and 1d. maximum demand system, or 1½d. per unit. The chief engineer is Mr. Arthur Ellis.

General Statement.

For year ending March 31st ...	1906.	1905.
Total capital expended	£244,694	£223,024
Number of units sold—		
Private supply, lighting	1,609,462	1,543,351
Power and heating	479,128	351,709
Public lighting	1,107,697	872,544
Total number of units sold ...	3,196,287	2,767,604
Equiv. No. of 8-C.P. lamps connected ...	147,725	129,362
H.P. of motors connected	1,179 H.P.	879 H.P.
Number of public lamps	578 arcs, 129 inc.	518 arcs, 129 inc.
Maximum load in KW.	2,076 KW.	2,036 KW.
Revenue account—		
Gross revenue	£35,962	£32,698
„ expenditure	£21,222	£20,181
„ profit	£14,740	£12,517
Average inclusive price obtained per unit—		
Private supply, lighting	3·66d.	3·66d.
Heating and power	1·39d.	1·42d.
Public lighting	1·72d.	1·78d.

Revenue Account, 1906.

Gross revenue...	£35,962 =	2·7d. per unit.
Works and distribution costs (inc. pub. ltg.)	£8,778 =	·67d. „
El. Dept's total working costs	£12,064 =	·91d. „
Energy purchased from Tramways Department ...	£9,158 =	·69d. „
Gross working expenditure ...	£21,222 =	1·60d. „

Profit Statement, 1906.

Interest on loans, &c.	£8,362
Sinking fund	4,770
Balance on year's working carried forward ...	1,608
Gross profit	£14,740

Bristol Municipal Electricity Supply.

The statement of accounts for the last year and attached reports by the Electrical Committee, the City Electrical Engineer, and by Prof. Dicksee on the question of depreciation, are full of interest; they not only cover electrical progress at Bristol, a by no means negligible feature, but also deal clearly with the vexed and important question of making adequate provision for wasting assets and their renewal.

The year's working discloses an increased sale of energy of some 10 per cent., for which power supply appears to be mainly responsible. The influence of the power connection is also shown in the load factors and working costs of the departments' two generating stations, in regard to which we cannot do better than quote the City Electrical Engineer's report:—

"The total (working) cost . . . . has gone down from £31,935 . . . . to £30,784, a decrease in the total cost of about 3 per cent. although the output has increased by one-tenth." It is noted that this decrease is an all-round one, but that coal costs, as in 1905, show a marked improvement, being nearly 20 per cent. better. He proceeds:—

"The bulk of the supply for power purposes has been generated at the Temple Back Works, and the analysis shows that the works cost, at Temple Back, has this year come out lower than at Avonbank, although Avonbank is by far the more economical station." As the Avonbank Station takes over the bulk of the load, no doubt greater improvement still will be seen.

The works cost analysis, referred to above, is as follows:—

	Temple Back.	Avonbank.	Combined system.
Lb. fuel	8·90	7·97 ...	8·33
	Pence.	Pence.	Pence.
Coal	·372	·329 ...	·346
Oil, &c.	·036	·043 ...	·040
Wages	·216	·212 ...	·259
Repairs	·059	·124 ...	·151
Works costs ...	·683 (·982)	·708 (·793)	·796 (·969)
Rent, rates and taxes	— ...	— ...	·150
Management ...	— ...	— ...	·242
Total working cost	— ...	— ...	1·188 (1·379)

The bracketed figures are for 1905.

The units sold from the two stations respectively in 1906 were:—(T.B.), 2,248,338; (A.), 3,562,630, and in 1905 (T.B.), 1,962,214; (A.), 3,255,314.

Probably due to the reduction in price in October, 1905, the gross revenue for the past year is only £1,000 ahead of that for 1905; the reduced working costs, however, enabled the department to show a gross profit of £39,879, as compared with £37,752 in 1905. After meeting financial charges a net profit of £6,115 remained, which compares with £10,860 in 1905, the difference being entirely due to increased capital charges resulting from the extensions recently carried out at Avonbank and elsewhere.

The prices charged are:—Private lighting, 3½d. (day) and 4½d. per unit; power, 1½d. to ⅝d. per unit. The chief engineer is Mr. H. Faraday Proctor.

General Statement.

	1906.	1905.
For year ending March 25th		
Total capital expended	£671,617	£590,984
Number of units sold—		
Private supply { lighting	2,793,993	2,620,387
Private supply { power	2,183,373	1,759,085
Public lighting	833,602	838,056
Total number of units sold	5,810,968	5,217,528
Equivalent No. of 8-c.p. lamps connected	302,846	274,176
H.P. of motors connected	3,972	3,213
Number of public lamps	677 arc.	677 arc. 9 inc.
Maximum load in kw.	4,840	4,284
Revenue account—		
Gross revenue	£70,664	£69,687
„ expenditure	£30,785	£31,935
„ profit	£39,879	£37,752
Average inclusive price obtained per unit—		
Private supply { lighting	3·85d.	4·18d.
Private supply { power	1·15d.	1·24d.
*Public lighting	3·42d.	3·40d.

* Includes cost of attendance and repairs, which is repaid to the department.

Revenue Account for Year 1906.

Gross revenue	£70,664	= 2·693d. per unit.
Works and distribution costs (including public lighting)	£21,194	= ·87d. „
Total working costs	£30,785	= 1·188d. „

Profit Statement, 1906.

Interest on loans, &c.	£20,015
Sinking fund	13,749
Net profit on year's working	6,115
Gross profit	£39,879

Bristol and Depreciation.—The question of the financial position of the Bristol electrical undertaking having arisen, the Electrical Committee consulted Prof. Lawrence R. Dicksee, of Birmingham University and of Messrs. Sellars, Dicksee & Co., chartered accountants, London, and Sir William H. Preece, in regard to the matter.

Prof. Dicksee's report deals largely with the question of depreciation, based on the life of the various assets as estimated by Sir Wm. Preece. He states that the Committee's questions resolve themselves into the following:—

(*a*) Can the revenue account be relieved of annual contributions to sinking fund in respect of assets displaced, provided a depreciation fund equivalent to the outstanding debt thereon has been provided out of revenue at the time of such displacement?

(*b*) Is ample provision being made for depreciation?

He gathers that it is not the Committee's policy to provide both for the repayment of loans and for the renewal of wasting assets when such becomes necessary; they are desirous, however, of making any necessary financial provision.

He points out that if the Statutory Sinking Fund equals the true depreciation charge, no further charge is necessary; where, however, the sinking fund is insufficient for that purpose a further provision is necessary, and, on the other hand, a "long-lived" asset on which the loan has expired can be renewed by reborrowing, but the excess on long-lived assets would not be available to meet the deficits on "short-lived" ones. In order to arrive at an equitable financial adjustment Prof. Dicksee calculates, for the "long-lived" assets, the proper charge against revenue to accumulate at 3 per cent. compound interest to a sum equal to the original expenditure (less the residual value), which he makes £5,363·66 per annum. The sinking fund in respect of the same items works out at £10,921·44 per annum, or an excess of £5,557·78 against which must be set the compensating error due to the "short-lived" assets.

In respect of the latter the proper charge is calculated at £4,380·85 per annum, a sum which exceeds the sinking fund payments by £1,885 67.

The report continues as follows:—

"It is important to bear in mind that, while the deficit referred to in the preceding paragraph can be properly set against the surplus mentioned . . . . for the purpose of ascertaining the true net profit of the undertaking (thus showing that on the present system of accounting the true net profits are, upon the whole, decidedly in excess of those stated in the published accounts), no such set-off is available in practice, in that each loan must be separately regarded, and all renewals must of necessity be charged against revenue (or against a reserve for depreciation), until such time as, having redeemed the original loan out of the proceeds of which the assets were acquired, it becomes possible to again borrow for renewal purposes. It will thus be seen that, so long as the capital expenditure remains upon the scale obtaining on March 25th, 1905, a sum of at least £1,885·67 must be charged against each year's revenue in addition to the statutory sinking fund instalments. But even if this annual sum were to be set aside in the future, it would not suffice to compensate for the fact that since the dates when these assets were respectively acquired no such annual provision has in point of fact been systematically made. I estimate that, had such provision been systematically made from the first, it would, on March 25th, 1905, have accumulated to £12,629·62, which sum invested at 3 per cent. would, on March 25th, 1906, have amounted to £13,008·50."

Here it is noted that the balances on the so-called "reserve fund account," and "depreciation and contingency account," amount to £16,000 approx., and this amount could be utilised for an adequate reserve (for renewals) fund, to be increased by future annual instalments from revenue, of £2,500 (an amount on the safe side of the calculated sum of £1,885·67).

This latter fund would be available to make up any deficiency in the sinking fund repayments when an asset required renewal.

The actual future annual instalments would, of course, be dependent on the capital expenditure from time to time, and on the nature of the assets, and would require periodic estimating.

The foregoing recommendations refer particularly to replacements or renewals of plant, ordinary repairs and renewals of parts being charged against revenue in the ordinary way.

Having satisfactorily provided for the full amount of the previous loan on any asset, it is anticipated that no difficulty will be experienced in obtaining sanctions for further loans for replacing that asset.

CITY NOTES.

The United Electric Car Co., Ltd., Preston.

The report of the directors, to be submitted to the eighth ordinary general meeting, to be held at the offices of the company, Strand Road, Preston, on Thursday, September 20th, at 12 noon, says that, during the year ending June 30th, 1906, the works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest amounting to £2,500, and charging £6,465 for depreciation, the profit for the year is £13,532, to which is added £3,462 brought from last year, making a total of £16,994; after deducting preference dividend for the period ending December 31st, 1905, £2,712; there remains an available balance of £14,282. The directors recommend that this amount be dealt with as follows: Preference dividend for the half-year ending June 30th, 1906, £3,000; write off portion of preliminary expenses in connection with the purchase of Hadley and Manchester works, and the issue of preference shares, £1,646; dividend on the ordinary shares of 5 per cent., less income-tax, for the year ending June 30th, 1906, £7,500; carry forward to next year, £2,136: total £14,282.

Electrical Shares on the Berlin Exchange.—The new issues of electrical shares in Germany during the past two or three years have brought an accession to those which were already quoted on the Berlin Stock Exchange. In the year 1903 there were 16 securities in the list, and these have now been increased to 25. The additions represent shares in the Bergmann Electricity Works Co., Brown, Boveri & Co., the Barcelona Electricity Co, the German Transmarine Electricity Co., the Sudwest Electricity Works, the Electro-technical Works of Max Schorch & Co., the Felten and Guilleaume-Lahmeyer Works Co., the Rhenish-Westphalian Electricity Works and the Siemens Electrical Operation Co. These accessions form a sharp contrast to the period of quietness which followed the crisis of earlier years, which required time in order to heel the financial wounds which had been inflicted. It is expected that further new issues will be introduced on the Berlin Exchange in a short time. The hope is, however, expressed that the initial quotations will not be fixed too high, as the only result would probably be a speedy decline. The mistake of making excessive quotations at the beginning has already been made in the case of several securities brought forward in 1905 and in the present year, which are now lower than the initial rates quoted on their introduction.

Dick, Kerr & Co., Ltd.—The preference and ordinary transfer books will be closed from September 17th to September 29th for preparing dividend warrants.

Stock Exchange Notice.—Applications have been made to the Committee to allow the following to be quoted in the Official List:—

County of London Electric Supply Co., Ltd.—Further issue of 10,000 6 per cent. cumulative preference shares of £10 each, fully paid.

South Metropolitan Electric Light and Power Co., Ltd.—The transfer register for the 4½ per cent. mortgage debentures will be closed from September 19th to 30th, both days inclusive, for the preparation of interest warrants.

Canadian General Electric Co., Ltd. — The usual quarterly dividend of 2½ per cent. has been declared.

Mexico Electric Tramways, Ltd.—The traffic returns for the month of August amounted to $364,700; deducting expenses the net revenue was $172,100.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	*
Aberdeen	Sep. 5	3,540	+ 454	14	22,140	+ 162	14·4	..
†Ayr	,, 1	362	+ 5	16	6,598	— 32	8	..
Bath	,, 8	2,211	+ 703	36	29,972	+ 5,437	13	..
Belfast	,, 7	7,318	+3,249	36	118,180	+35,736	40	+ 6½
Birkenhead	,, 9	2,279	+ 1	23	25,271	+ 319	13·5	..
†Blackburn	Aug. 29	1,039	+ 90	22⅔	24,153	+ 1,329	13·5	..
Blackpool Corp. ..	Sep. 6	5,069	+ 639	23	37,018	+ 2,211	11·87	..
,, —Fleetw'd	,, 8	3,348	+ 867	10	16,539	+ 2,148	8·25	..
† ,, —Lytham	,, 2	825	+ 155	39	12,897	+ 1,353	7½	..
Bolton	,, 9	4,512	+ 822	23	50,927	+ 3,719	26	+ 1
Bournemouth ..	,, 5	4,972	+1,032	22½	41,141	+ 8,635	18·75	+ 6¾
Bradford	,, 8	9,749	+ 944	23	109,495	+ 4,842	55	+ 2
Brighton	,, 9	2,715	+ 252	23	26,044	..	9·5	..
Bristol	,, 7	10,984	+ 834	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Aug. 31	468	+ 2	35	7,685	+ 661	3·65	..
Barnsley	,, 31	388	+ 11	,,	5,733	+ 52	..	..
Barrow	,, 31	661	+ 56	,,	9,088	+ 530	5·37	..
Cavehill	,, 31	265	+ 167	,,	3,209	+ 1,328	..	..
Devonport	,, 31	1,061	+ 105	,,	16,044	— 258	8·85	..
Gateshead	,, 31	2,018	+ 113	,,	33,804	+ 1,836	11·25	..
Gravesend, N'fleet	,, 31	594	+ 86	,,	8,536	+ 349	6·5	..
Greenock	,, 17	1,666	+ 112	33	21,904	+ 905	7·25	..
Hartlepool	,, 31	811	+ 172	35	10,672	+ 1,328	6·72	..
Kidderminster ..	,, 31	315	+ 22	,,	4,374	— 14	..	..
Leamington ..	,, 31	400	— 43	,,	6,296	+ 2,689	3	..
Merthyr	,, 31	402	+ 30	,,	6,851	+ 152	2·9	..
‡Metropolitan ..	,, 31	7,909	+1,456	,,	119,649	+28,387	22	..
Middleton	,, 31	963	+ 50	,,	12,616	+ 366	8·5	..
Mid. Joint Com'tee	,, 31	20,096	+ 87	,,	356,399	+17,813	..	..
Oldham — Ashton	,, 31	1,359	+ 40	,,	19,985	+ 538	9·13	..
Peterborough ..	,, 31	322	+ 15	,,	4,621	— 314	5·31	..
Potteries	,, 31	3,459	+ 115	,,	61,822	+ 3,051	29	..
Rothesay	,, 31	1,104	+ 158	,,	9,076	+ 1,398	2·75	..
Southport	,, 31	1,024	— 13	,,	11,651	+ 220	8·17	..
Swansea	,, 31	1,980	+ 84	,,	29,278	+ 4,802	5·5	..
Tynemouth	,, 31	811	+ 80	,,	9,530	— 99	3·75	..
Weston-s-Mare ..	,, 29	919	+ 109	,,	5,762	+ 324	3	..
‡Worcester	,, 31	709	+ 7	,,	10,059	— 754	5·75	..
Wrexham	,, 31	256	+ 35	,,	3,623	+ 56	..	..
Yorks. Wool. Dist.	,, 31	1,951	+ 552	,,	31,633	+ 9,087	17	..
Miscellaneous ..	,, 31	279	— 38	,,	3,729	— 601	..	..
Burnley	Sep. 8	2,606	+ 378	35	..	..	7·5	..
Burton-on-Trent ..	,, 9	640	— 5	23	7,308	— 438	9·5	+ 1
†Bury	Aug. 26	1,032	..	21	21,422	..	10·5	..
Cardiff	Sep. 1	4,662	+ 520	22	47,795	— 387	15·87	..
Carlisle	,, 8	461	+ 76	36	6,760	— 3	..	..
Chatham and Dist.	,, 6	1,924	+ 480	36	24,151	— 61	12·84	+ 3·5
Colchester	Mar. 7	327	— 5	31	5,600	..	7⅓	+ ⅓
Cork	Sep. 6	1,145	+ 68	36	17,489	— 270	9·89	..
Croydon	,, 7	3,177	+ 470	14	23,042	+ 1,730	11·25	+ ·5
Darlington	,, 1	469	+ 29	22	4,801	+ 163	4·87	..
Darwen	,, 7	552	+ 66	23	5,975	+ 250	4·36	..
†Dover	,, 1	372	+ 96	22	6,366	+ 917	4·75	+ 1½
Dublin	,, 7	14,137	+3,339	10	58,988	+ 3,177	48·75	+ ·25
Dundee	,, 5	2,519	+ 682	16	18,323	+ 3,975	13	+ ·5
East Ham	,, 8	1,968	+ 339	23	22,189	+ 2,083	8	+ ⅓
Exeter	,, 7	732	+ 29	23	7,173	— 335	4·25	..
Glasgow	,, 8	35,565	+4,825	17	242,358	+20,889	81·75	+ 6
†Halifax	Aug. 29	1,760	+ 89	22	38,419	+ 1,044	37	+ 1·5
Hastings	Sep. 7	2,796	..	..	..	..	..	..
Huddersfield ..	,, 9	3,169	+ 422	23	36,080	+ 3,387	28	..
Hull	,, 8	4,506	+ 179	23	52,547	+ 1,131	13	..
†Ilford	,, 1	525	+ 58	22	11,493	+ 67	6·37	..
†Ilkeston	Aug. 29	154	+ 32	22	3,045	+ 280	3·5	..
†Ipswich	Sep. 2	584	+ 88	22	10,559	— 154	10·5	..
Isle of Thanet ..	,, 8	3,371	+ 670	36	25,758	+ 202	11	..
Kilmarnock	,, 8	326	+ 16	17	2,802	— 68	4·12	..
Kirkcaldy	,, 5	628	+ 182	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 6	1,982	+ 152	36	31,491	+ 5,781	12·56	+ ⅓
Leeds	,, 1	13,066	+1,087	22	141,892	+ 7,688	96	+ 6½
Leicester	,, 8	4,656	+ 450	36	79,714	+ 4,937	..	..
Leith	,, 1	1,085	+ 329	15½	8,634	+ 4,296	6	+ 1
Liverpool	,, 1	22,404	+ 637	35	376,549	+ 6,070	104	+ 1
‡L.C.C.	Aug. 25	50,712	..	21	557,855	..	98	+46⅔
London United ..	Sep. 7	14,792	+2,764	36	227,503	+15,315	..	..
†Lowestoft	,, 8	387	+ 22	50	9,011	— 543	3·5	..
Manchester	,, 8	29,849	+4,551	23	321,854	+19,141	146	+21
Newcastle	,, 8	7,879	+ 397	23	94,782	+ 5,863	25·5	..
Newport	,, 8	1,393	+ 183	23	15,131	+ 825	14·5	+ 1·5
Northampton ..	,, 7	1,003	+ 108	23	10,885	+ 154	5·5	..
Oldham	,, 9	3,873	+ 798	24	44,301	+ 4,299	23·75	..
Pontypridd	,, 8	343	+ 31	23	3,979	+ 61	3·25	..
†Portsmouth ..	,, 8	2,687	+ 503	23	52,620	— 788	14·5	..
†Preston	Aug. 29	780	+ 74	..	..	..	10	..
Reading	Sep. 6	1,423	+ 46	23	15,212	+ 5	7·5	..
Rochdale	,, 8	2,413	+ 802	22	25,424	+ 7,401	20·6	+ 1¾
Rotherham	,, 6	1,039	+ 169	23	11,682	+ 1,209	9·33	..
Salford	,, 3	9,371	+ 850	22	102,613	+ 2,051	38·9	..
Sheffield	,, 9	10,881	+1,279	24	128,211	+ 8,325	35·75	+ 1½
Southampton ..	,, 5	2,328	+ 162	22½	23,452	+ 160	..	..
Southend-on-Sea ..	,, 5	1,375	+ 198	23	11,054	+ 468	6	..
†Stalyb'dge, Hyde, &c	Apr. 21	807	+ 100	3	2,456	..	21	..
Stockport	Aug. 17	2,295	+ 216	20	20,492	+ 5,722	15·5	+ 4
Sunderland	Sep. 9	3,256	+ 464	23	34,376	+ 1,885	10·87	..
Swindon	July 3	331	— 83	13½	2,642	— 49	4·4	..
Tyneside	Sep. 5	1,027	+ 205	36	16,530	+ 1,289	8·87	..
Walthamstow ..	,, 8	1,459	+ 317	23	15,455	..	10	..
West Ham	,, 6	4,766	+ 467	23	53,649	+13,759	14·7	+ 1·4
Wolverhampton ..	,, 5	1,746	..	..	..	..	10	..
Yorks. W. Riding ..	,, 9	1,875	+ 349	36	30,167	..	..	..
Baker St.-Waterloo	,, 8	2,753	..	10	13,180	..	4	..
Cen. London Rly. ..	Aug. 25	9,955	— 547	8	43,396	— 2,027	6	..
City & S. Lon. Rly.	Sep. 9	4,714	— 173	10	24,044	+ 1,123	6·25	..
Dublin-Lucan Rly.	,, 7	297	— 14	10	1,466	— 56	7	..
G. N. and City Rly.	,, 8	3,102	+ 135	10	15,480	+ 1,122	3·5	..
L'pool Overh'd Rly.	,, 9	3,000	+ 5	10	15,826	— 511	6·65	..
Mersey Railway ..	,, 8	3,162	+ 135	10	16,299	+ 1,211	4·5	..
Metropolitan Rly. ..	,, 11	27,840	..	10	143,280	..	70·5	..
Met. District Rly. ..	,, 9	13,755	+ 967	10	71,759	+ 7,718	24	..
Anglo-Argentine ..	,, 9	30,792	+3,696	36	533,497	+58,482	48	..
§Auckland	Aug. 17	9,558	+ 761	32½	80,296	+ 5,262	18·64	..
§Brisbane	,,	14,186	+1,415	..	..	..	..	..
§Brit. Columbia Rly.	July	18,433	+2,807	4½	18,433	+ 2,807	..	..
Bu'n's A'r's E.T. Co.	Aug. 11	2,437	+ 54	32	43,462	+ 7,401	24	..
Bu'n's A'r's-Blgr'no	Sep. 2	7,027	— 265	35	125,093	+ 6,663	..	..
Calcutta	,, 10	5,884	+ 102	..	..	..	..	..
§Cape Electric T. Ld.	May	14,806	..	..	..	..	..	..
§Geneva	July	8,188	..	..	..	..	..	..
§Kalgoorlie	Aug.	5,005	..	35	34,892	..	20·5	..
Madras	,, 31	970	+ 218	35	15,214	+ 1,536	..	..
Perth (W.A.) ..	Sep. 7	2,803	+ 245	36	52,776	+ 3,253	24·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Money once more rules the financial roost. Whatever may happen on Thursday, the present outlook certainly justifies the apprehension of a rise in the Bank Rate, and Consols are therefore weak and depressed. As usual, this reacts upon Home Railway stocks, the prices of which are, as a whole, proportionately weak with Consols. Electrical railway issues have not altered much. As regards the steam lines, there is a fear lest Parliament when it meets may introduce fresh labour legislation, at the expense of the capitalist, to give workmen shorter hours and more money.

Notwithstanding the agitation against the revised fares on the District Railway, the stock remains steady at 23½, and Metropolitan is 64. The Wimbledon clamour is somewhat ineffective so far, because of the fact that competition has scarcely made itself felt, the South-Western service being of little use to the hundreds who use the District. But the Central London can hardly fail to benefit by the change; passengers from Ealing and neighbourhood will see to that. The season of the motor-omnibus draws to its conclusion, and with the coming of autumn and winter there should be better traffics for the Twopenny Tube. City and South London Ordinary has fallen to 44, but there are anxious buyers of the 1901 Preference stock at 115. Baker Street and Waterloo Debenture remains at 90½. A new light railway, with electricity for its motive power, is to be constructed between Woking and Bagshot. At the former place the line will join the London and South-Western goods sidings, and the cost is placed at £150,000.

Most of the changes in the Telegraph list are in the upward direction: the only complaint is that there are not more of them. Anglo-Americans happen to be easier, due to the sales of some few operators taking profits prior to the settlement. The price may be very different on Friday from what it is now. The "B" Stock is ½ lower at 114. Direct United States Cable shares have recovered the 5s. lost a week ago, and are 15¾, and "China" shares are ⅛ better at 14⅝. West African Telegraphs rose to 10 upon the revival of interest and prices in the "Jungle" mining market. Several Debentures are rather harder. The Cuban rebellion has, so far, failed to produce any effect upon Cuba Telegraph shares, but Chili Telephones at 7 have gained a further 10s., and are now back to the price at which they stood before the earthquakes made it shake. Marconi shares at £1 were a little lower, but recovered again to 1 1/16. Indo-Europeans improved to 60, but Great Northerns continue at 38½. At 14¾ Globe Telegraph and Trust Preference are harder. Only the Third Preference have altered in the National Telephone group, the price slipping to 5 1/16.

Supply shares are very quiet. Charing Cross Ordinary advanced to their par level of £5, and the Debenture stocks of the Urban and the Oxford Companies are both a point up. City of London Ordinary and County of London Ordinary lost 2s. 6d. of their recent rallies, which served to bring in sellers. On the whole, the market has rather relapsed, although prices keep about the same, nominally. Business is exceedingly quiet. Monday was pronounced the least active day for some time past.

Traction descriptions are nearly as featureless as electricity supply shares. Anglo-Argentine Ordinary fell ⅛ to 7 7/16, and Auckland Debenture has risen a point to 104. The shares of the latter company are about 11. Against a fall of ⅛ in British Electric Traction Preference must be set small rises in the company's two debenture stocks. British Thomson-Houston Debenture is quoted at 96 *ex* dividend. Other changes in the manufacturing department include ⅛ fall in Babcock Ordinary, and a rise in British Insulated Preference shares.

Particulars are in course of circulation respecting the Sao Paulo Tramway, Light and Power and the Rio de Janeiro Tramway Light and Power Companies. The former is a well-established concern, its $100 shares standing at 142, and the 5 per cent. First Mortgage Gold bonds at 99¼. The latter, incorporated two years ago, has not yet finished all its construction work, but is earning more than sufficient to pay the 5 per cent. interest on its bonds, the price of which is about 81, while the shares stand at 47. Both companies have good directorates, and the bonds look attractive in their respective classes.

Electricity Supply Canvassers Should Note This.—At a meeting of the Liverpool Health Committee on Thursday last week, reference was made to the report of Dr. Brislee, of the University, on the unnecessarily and seriously dangerous gas supplied to some of the city districts, and a deputation was appointed to wait upon the Lighting Committee, who should be asked to approach the President of the L.G.B. on the subject.

Newport Transporter Bridge.—This new electric transporter bridge of the Newport Corporation was opened on Tuesday by Viscount Tredegar.

Bank Rate Altered.—The Bank rate was yesterday raised to 4 per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Sept. 4th.	Closing Quotations Sept. 11th.	Business done week ended Sept. 11th, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾ — 4	2¾ — 4	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	87 — 93	87 — 92	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	66 — 68	66 — 68	..	..	— ½
8,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	114 —115	113½—114½	114½	114	..
8,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½%	22⅜— 23⅝	23⅛— 23⅝	23½	23	— ½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	99 —101 xd	99 —101 xd	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6½ — 6⅞	6⅞ — 7⅛	..	..	+ ⅛
1,922,855£	Commercial Cable Stg. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97½ — 99½	97½ — 99½	98	..	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅞ — 3⅞	3⅞ — 3⅞	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 9½	8½ — 9½	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	4½%	15¼— 15⅝	15¼— 16	15⅝	15½	+ ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147	144 —147	146¾	145	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	92	91	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	109¼	107¼	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14¼ — 14⅝	14⅜ — 14⅝	14 7/16	14 5/16	+ ⅛
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105 —107	105½—107½	103½	..	+ ½
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	101 —103	..	..	+ 1
190,887	Globe Telegraph and Trust	10	£3	5½%	5⅜%	5½%	10¾ — 11⅛	10¾ — 11⅛	11⅛	10 15/16	..
190,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14⅜ — 14⅝	14⅝	14 23/32	+ ⅛
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	37½ — 39½	37½ — 39½	37⅛	..	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	18 %	13 %	58 — 60	58¾ — 60¾	..	..	+ ¾
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅜— 1 7/16	1⅜— 1 7/16	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	⅞ — 1	1 1/16 — 1 1/16	..	..	+ 1/16
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1/16 — 1 1/16	⅞ — 1	..	..	— 1/16
1,983,388	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	111	109½	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	109 —111	109 —111	110½	109½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 3/16 — 5¼	5 3/16 — 5 5/16	5 5/16	5⅜	— 1/16
2,000,000	Do. do. 8½ % Deb. Stock Red. ..	Stock	8½%	8½%	8½%	8½%	98 —100	98 —100	..	..	..
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102½ —104½	102½ 104½	103⅛	103½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 5/16	1 5/16 — 1 5/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %	7½— 7⅝	7½— 7⅝	7 15/16	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅛ — 10	9⅜ — 10⅛	..	..	+ ⅛
80,008	W. Coast of America, 1 to 80,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	3/16 — ¼	3/16 — ¼	..	..	..
150,000	Do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½ —102½	100⅜ — 103⅛	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	5 %	14½ — 14¾	14½ — 14¾	14 15/16	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	— —	— —	..	..	..
663,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	..	..	..
88,331	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
84,568	Do. do. 6 % Cum. 1st Pref. ..	10	7 %*	7 %*	6 %	5 %	6½ — 6⅝	6½ — 6⅝	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref. ..	10	Nil	Nil	Nil	Nil	4½— 5½	4½ — 5½	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams. 360,000 to 450,000	5	..	..	5 %	5 %	7 1/16 — 7 3/16	7 1/16 — 7 1/16	7⅞	7⅞	— ⅛
100,000	Do. Nos. 430,008 to 910,007 and 560,008 to 580,007 ..	5	..	..	..	..	7⅛ — 7⅜	7 — 7⅛	7⅛	7 1/16	— ⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅜— 6	5⅜— 6	5⅝	5⅛	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	102 —104	103 —105	104 1/16	103¼	+1
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	4½— 4⅝	4⅛— 4⅜	86/10½	85/-	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3⅜— 4	3⅜— 4	78/9	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6⅛ — 6⅜	6¼ — 6⅜	..	..	+ ⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5 — 5½	5 — 5½	6¼	6¼	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4½	4 — 4½	5½*	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	17 —110	117 —120	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	106 —104	106 —109	108⅜	108	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103½ —105½	103½ —105½	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
188,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5½ - 6	5½ — 6	..	..	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9½ - 10	9¼ - 9⅞	9 13/16	9¼	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	114 —117	115 —118	116½	116	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92 — 95	92½ — 94½	95	94⅜	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¾— 7¼	6¾ — 7¼	6¾	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅜ — 6	5⅜ — 6¼	..	..	+ ⅛
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	97 —100	97 —100	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1½— 1¾	1½— 1¾	..	..	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	1⅝— 1¾	1⅝— 1¾	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1½— 2	1½ — 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 — 98 xd	96 — 98	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3⅜ — 3⅝	3⅜ — 3⅝	70/-	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5½— 5¾	5½ — 5¾	5⅝	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5½	5 — 5½	5	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	104 —106	104 —106	104½	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —106	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅝— 8⅞	8⅝ — 8⅞	8⅞	8 13/16	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8¼— 8⅝	8 — 8⅜	..	..	— ⅛
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	105	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½ — 11½	10½ — 11½	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5¾	5⅜ — 5¾	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
491,229	Cape E. Trams., 1 to 491,229	1	..	15 %	10 %	5 %§	⅛— ¼	⅛— ¼	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	21/10½	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87 xd	85⅞	85½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99 xd	98¼	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	75	..	..
480,000	City and South London Railway	Stock	3½%	2¾%	3½%	1¾%	44 — 46	43 — 45	44½	44	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1⅜ — 1½	1⅜ — 1½	..	..	..
103,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Sept. 4th.	Closing Quotations Sept. 11th.	Business done week ended Sept. 11th, 1906. Highest.	Lowest.	Rise or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	..	10 %	..	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5%	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	1.0%	..	1¾ — 1¾	1¾ — 1¾	33/6	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½%	..	2¾ — 3	2¾ — 3	..	..	..
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	½ — ½	½ — ½	..	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	7 %	1½ — 2½	1½ — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	85 — 88	85 — 88	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3¾ — 4	3¾ — 4	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —102	101 —102	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13 xd	12 — 13	12¹¹/₁₆	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5¾xd	5⅝ — 6⅛	..	..	+ ⅛
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107½—109½	107 —109	..	..	— ½
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107½—109½	107 —109	..	..	— ½
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅜	17¹/₁₆	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	13%	1½%	Nil	1¹⁵/₁₆— 1¹⁵/₁₆	1¹⁵/₁₆— 1¹⁵/₁₆	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4½ — 6½	4½ — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8½	8 — 8½	..	..	+ ⅛
899,930	Do. do. 50,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	3¾ — 4½	3¾ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8¾ — 9½	8¾ — 9½	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	94 — 97	95	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛ — ⅛	⅛ — ⅛	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1⅛ — 1⅛	1⅛ — 1⅛	17/9	17/3	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	98⅜—100½	98⅜—100½	99⅛	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4½ — 5⅝	4½ — 5⅝	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6½ — 7½	6½ — 7½	6¹/₁₆	..	— ⅛
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7¾ — 8½	7¾ — 8½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	33½ — 35½	33½ — 35½	35	34	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	91½	90	..
540,000	Waterloo & City Railway, Ord. Stock	100	8½%	8½%	3½%	8½%	101 —104	101 —104	..	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	8½%	3 %	Nil	Nil	⅜ — 1½	⅜ — 1½	..	..	..
66,666	Do. 6 % C. P., 80,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2¼ — 3¼	2¼ — 3¼	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	102½	102	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¼ — 9	8¼ — 9	8⅜	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8	7⅛ — 8	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4⅜ — 5⅛	5⅛	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4¼ — 5	4¼ — 5	97/6	95/-	+ ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,435	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½ — 6	5½ — 6	..	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10⅞ — 11⅜	10⅞ — 11⅛	..	..	— ⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	103	102½	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2¹⁵/₁₆— 3⅛	2¹⁵/₁₆— 3⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	5⅜	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8¾ — 9⅜	8⅞ — 9⅜	8⅞	..	— ⅛
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11⅜ — 12½	11⅜ — 12½	..	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	110	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	102	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3⅜ — 3⅞	3⅜ — 3⅞	70/-	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	5¹/₁₆	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101	..	..
10,000	Folkestone, 1 to 10,000	5	..	5%	5%	5%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	7⅞ — 8⅜	7⅞ — 8⅜	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½%	12 %	10 %	9⅜ — 10⅜	9⅜ — 10⅜	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1¼ — 2⅜	1⅛ — 2⅜	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜ xd	5 — 5⅜xd	5¹/₁₆	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8¼ — 9	8¼ — 9	8⅜	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £8 pd.	5	4½%	4½%	4½%	4½%	5¼ — 5⅜	5¼ — 5⅜	5¹¹/₃₂	5⁵/₁₆	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	99½	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅜ — 6⅛	5⅜ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6¼ — 6⅜	6¼ — 6⅜	6⅜	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	97 — 99	98 —100	..	..	+1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10¼ — 11¼	10¼ — 11⅜	11¹/₁₆	10⅜	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2 — 2⅜	2 — 2⅜	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 75	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	3 — 3½	3 — 3½	..	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	1¹/₁₆— 1⅛	1¹/₁₆— 1⅛	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1¹/₁₆— 1⅛xd	1¹/₁₆— 1⅛xd	25/-	23/9	..
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3½ — 4	3¾ — 4	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4¾ — 5	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	98 —101	99 —102	100½	..	+1
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9½ — 10⅜	9⅝ — 10⅜	10⅛	10	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	5¹¹/₃₂	..	..

Shares not officially quoted:—Mackay Companies, ord., 76—78. Pref. 73—75.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. June 21st, 1906).

EARTH IN COLLIERIES.

In a paper read before the recent annual meeting of the Institution of Mining Engineers, Mr. Sydney F. Walker deals with this very important question, with reference to the new special rules for the use of electricity in collieries, and shows to some extent the futility of attempting to comply with the rules in connection with earthing.

Practically, the paper hinges upon a series of experiments carried out by Mr. G. C. Wood, B.Sc., at the Armstrong College, Newcastle-upon-Tyne, to obtain the specific electrical resistance of coal and the rocks lying above and below any seam of coal, and it may be interesting to give the results as shown in the following table :—

Specific Resistances of Minerals found in Mines.

Name of mine.	Description of mineral.	Specific resistances per cubic centimetre.
		Ohms.
Cowpen Mill Pit	Roof: black shale	446,000
Do.	Steam coal	36,000,000,000
Do.	Thill: grey sandstone ...	20,300
Murton	Roof: soft blue shale ...	432,900
Do.	Coal	33,900,000,000
Do.	Thill: blue shale	13,000
St. Hilda ...	Roof: black shale	337,000
Do.	Steam coal	80,100,000,000
Do.	Gas coal	33,000,000,000
Do.	Coarse coal	3,395,000,000
Do.	Thill: bluish-grey pasty shale	105,000
Skelton Park ...	Roof: dogger rock	52,100
Do.	Ironstone	167,000
Do.	Thill: bottom rock	52,000
Greenside ...	Lead ore	$7\frac{1}{3}$
Penrith	Peruvian sandstone	8,375,000
Do.	Carboniferous limestone ...	2,900,000
Barton	Do. do. ...	1,014,000

In addition to the above, it was also ascertained that a block of cement concrete flooring had a specific resistance of 754,000 ohms per cubic centimetre ; and it may also be interesting to note that the Barton carboniferous limestone is the limestone recently adopted by the North-Eastern Railway Co. to lay between the rails and sleepers on the electrified portion of their system.

It is thus at once seen that in the case of a dry mine a "good earth" is practically impossible, and even in the case of a wet mine in which all the districts worked are more or less wet or moist, there will still be a considerable amount of resistance between an earth plate near the generator on the surface and the frame of a machine earthed, say, to the rails some distance "inbye." Hence at some point between these extremes the earth would probably be at a low enough potential to enable a workman to receive a serious shock through coming into contact with the bare live wires. Several serious fatal accidents have occurred in mines, and it is remarkable to notice that most of these have occurred in mines using armoured cables, which is the class of cable recommended to be used by the special rules with earthed armouring. Water pipes and tram-rails have been suggested as a means of obtaining good earth, but in the case of the former, the pipes are in most cases only used to convey the water up-hill, and therefore are not continuous, and, further, it is conceivable that a water pipe conveying water from a wet district up-hill through dry and dusty galleries, and serving as an earthed return, might become a serious danger. Rails, on the other hand, are useless as an "earth," as they not only rest upon wooden sleepers, but are not close jointed, except on main rolleyways when they are "fished" together, but even in this case they could not be said to be electrically continuous. To remove these difficulties it has been suggested to use old ropes to form the earth, but here again it might be a difficult matter to make—and ensure they would remain so—electrically continuous.

In lieu of armoured cables, the special rules suggest running the cables in pipes, which is probably the very worst system of installing underground cables that can possibly be thought of, owing to the gathering of moisture inside the pipes, which absolutely destroys the insulation on the cables in a very short period.

Speaking of armoured cables, the author says :—

. . . . if two cables are armoured, the armour being earthed efficiently, and if the insulation of one of them breaks down, the armour becoming alive, the pressure in the conductor that has broken down is not thereby neutralised, only an important portion of the resistance from one path, the path through the insulation that is open to the pressure of the service is removed, and, though nothing may happen immediately, conditions may easily arise in which a dangerous pressure may exist between some metal that a man can touch and the floor upon which he is standing; and that not only despite the presence of the efficiently earthed armour, but in consequence of it, if the insulation of one cable has broken down. So long as the insulation is perfect all will be well, but immediately one armour becomes alive a totally different set of conditions is produced, the full scope of which it is difficult to forecast. There would be differences of pressure between the armour on different parts of the cable, and although these may not be great at first, when things are comparatively new, the constant changes, the constant deteriorations that are going on may produce the very difference of pressure which it is the object of the Departmental Committee to avoid.

The real trouble lies in the latter part of the extract, and no one without actual practical experience in mining operations can credit the rapidity and extent to which this does occur. It would appear therefore—and it has already been pointed out in our columns—that the very best system is to omit earth altogether, using only high class, low-density, well insulated cables, either rubber or bitumen, whichever will best withstand the conditions of the mine. Cheap bitumen cable is sometimes recommended for use in mines, by *electrical* contractors who have absolutely no idea whether it is suitable or not. The cable eventually gives trouble, which the manager has to bear, the contractor evading all responsibility, with the result that the system of electrical transmission is not recommended it being regarded as dangerous and unreliable. For the same reason it is questionable as to whether it is wise to take underground any current above 500 volts pressure, though in some cases pressures of 3,000 volts and over are being applied directly to motors underground. When new and in good order, there is no doubt high pressure may be perfectly satisfactory, but how long will it remain so? Further, it must not be forgotten that raising the pressure increases the "earthing" difficulty. Adopting such a pressure may save a few pounds in first cost, but where efficiency, safety, and insurance against breakdown are the principal factors, the question becomes one not lightly disposed of. It may be said that such a voltage is used in Germany, but there conditions are vastly different, capital expenditure is not considered, the collieries are worked in a leisurely manner, and a breakdown is not looked upon so seriously as in this country.

In America it is a common plan to use a bare earthed return wire, which is far in advance of the concentric uninsulated return as suggested by Mr. Walker ; but for three-phase current the best system is to adopt a well-insulated three-core cable with the neutral point "not earthed."

With regard to apparatus for recording leakage or indicating when an earth is on the system, there does not appear to be any difficulty with continuous current installations, but, practically speaking, the instruments are of very little value, and with long three-phase cables are absolutely useless, owing to the *capacity* of the cables.

Probably the best and most satisfactory means of indicating earth faults is to use a lamp or lamps connected between each main and earth through a fuse on each circuit, which may be frequently tested during working hours by the attendant, and as soon as an earth is indicated, no matter whether "slight" or "full," it should be at once reported and attended to and removed at the earliest possible moment. It matters little whether the leakage current is $\frac{1}{10}$ or $\frac{1}{1000}$ or $\frac{1}{10000}$ of the maximum supply current ; in a mine the insulation should be maintained as perfect as it is possible to be installed, by only using the best material, good machines, well-designed switchgear and decent switchboards, and a reasonable pressure.—T. C. F.

Manchester and Liverpool Electric Express Railway.—According to a notice in last Friday's *London Gazette* landowners and others whose property has been interfered with or rendered less valuable by the commencement, construction or abandonment of the above railway, and any others who claim to be entitled to any part of the fund in Court, are on November 1st to prove their claims before Mr. Justice Swinfen Eady in London.

A CHAT ABOUT STEAM TURBINES.

By E. AUSTIN.

Much has been written about steam turbines, so much, in fact, that it might appear unwarranted on the part of the author to revert to this subject. On the other hand, it is one that many engineers are always glad to hear about, hence its revival is, perhaps, not quite so uncalled for as at first sight it appears.

It is not the object of this article to discuss the turbine's merits or demerits, or its relative efficiency as compared with other prime movers, neither is it the object to consider turbines of different makes. The following will be confined to those constructed on the Parsons principle, the constructional details of which most readers are fairly familiar with. We will assume that a turbine has been installed in a reciprocating station ; that is to say, a station in which the plant has hitherto consisted of reciprocating engines, where the engineers are fully acquainted with all points in connection with their old plant, but are lacking in turbine experience. It is not surprising that in such a station a few errors of judgment sometimes occur. Of course, there is the contractor's engineer who is always very ready to give advice, but since the station engineer is inexperienced in this class of work, he often omits to ask the most important questions, and only finds this out when the contractor's man has left the job. Then, again, there is the instruction sheet ; this is a valuable help, but unfortunately the instructions are often rather brief, and, in the writer's opinion, they might well take the form of a book, which should be compiled by someone who has actually had to deal with the running and upkeep of this type of plant. It should be understood, however, that the writer has no fault to find with instruction sheets served out by any particular firm, other than that they are, as a rule, rather incomplete.

The first question that a man will ask when called upon to start a turbine is, Does it require warming up ? To this I would reply (in spite of the differences of opinion that appear to exist on this point) in the case of turbines working with clearances common in the Parsons type, decidedly yes ; moreover, they should be thoroughly warmed up. It is not sufficient for steam merely to appear at the neck glands, neither does it follow that the turbine is thoroughly warmed through when the exhaust pipe is felt to be hot. For a turbine to be ready for starting, steam should first circulate in every part, and it will found that the last part to become heated is that where the balance pistons are situated. It should be remembered that steam can only reach the dummy pistons by way of the balance pipes or ports ; it is evident that these are not filled until after the main cylinder, and it will often be found that while the exhaust end is perfectly hot, the steam end where the balance pistons are situated is quite cold. Many argue that turbines do not require warming through, but it is the writer's opinion that a large number of the breakdowns due to blade stripping can be traced to starting before the turbine is thoroughly hot. It should not be concluded, however, that a turbine takes longer to warm up than a reciprocating engine, for the reverse is the case, and with a little practice it is surprising how quickly large sets may be warmed up and set in motion, but it cannot be emphasised too strongly that with some parts hot and others cold, the blade clearances may be considerably reduced, and the chances of the moving blades catching is very great.

While the warming process is going on, the oil should be pumped up into the bearings by means of the hand pump, which is always provided where a rotary main oil pump is fitted, as this type is somewhat slower in starting to work than a reciprocating pump, and it is also desirable that they should be flooded. In order to make sure that the hand pump is working satisfactorily, a watch should be kept on the oil-gauge glass while the handle is being worked, and the turbine should not be set in motion until the oil is seen to fill several inches. When running up, the principal thing to be looked at is the oil-pressure gauge, and if the pressure is not seen to be indicated soon after starting the cause should at once be localised, as with such speeds oil is of vital importance, and the bearings will soon be found to smoke should the pump fail to work. The most common cause of a rotary pump's failing to work is due to its drawing air, and the trouble can generally be rectified by pulling up the joints on the suction side ; shortness of oil in the oil tank and stoppage in the suction are also sometimes responsible. The same troubles are also often present with reciprocating pumps, but, of course, in this case we sometimes experience failures caused by something getting under the valves, or by defective plunger packing. Well known as all these troubles are to engineers, it is surprising at times how their simple considerations are forgotten in the case of emergency.

When a turbine has first been installed, and is about to be set to work for the first time, all the keeps should be lifted, and the hand pump should be worked until the oil is seen to appear at each of the bearings. When reciprocating pumps are fitted, the connecting rod should be disconnected from the crank, and the plunger worked up and down by hand, and the keeps should be replaced one by one as the oil appears at the various bearings, for it is obvious that the oil will not appear at all the bearings at once. Should the oil fail to appear at any particular bearing, stoppage can, of course, be looked for. Those who have experienced trouble with scored bearings due to deficiency of oil will appreciate the necessity for these remarks, as the amount of work involved in removing the bearings and scraping them up and oil-stoning the shaft is of no light order. This applies more particularly to tube bearings, which are not split. To remove these, it is necessary practically to dismantle the whole of the turbine, and one experience of this kind is generally sufficient to render one chary of a second occurrence.

The high speeds at which turbines run generally causes the slow-speed man a little uneasiness at first ; but this soon wears off in a week or two, and the turbine is started up with as much ease as the reciprocating sets. A word of warning, however, is here necessary. Turbines, as is well known, are invariably fitted with emergency governors, which cut off the steam when a certain critical speed is reached. The excess speed at which the emergency governor acts varies slightly with the size of the turbine, and is generally somewhere in the neighbourhood of 10 to 15 per cent. Now, it is well known that tachometers are not amongst the most reliable instruments, especially when driven by means of a belt, and an error of 10 per cent. might quite well exist ; it is, therefore, advisable to check the tachometer at fairly frequent intervals, as the speed might reach the limit without being noticed if not correctly indicated on the tachometer. In the case of turbines fitted with reciprocating pumps, the speed may readily be tested by counting the number of strokes the pump makes per minute ; this multiplied by the reduction ratio of course gives the actual speed. The ratio can easily be obtained by lifting the steam end keep and counting the number of teeth on the gear wheel ; if this engages with a single thread, this is obviously the ratio. If, on the other hand, it engages with a number of threads, the ratio is $\frac{\text{teeth on wheel}}{\text{number of threads}}$. Where rotary pumps are fitted, the speed must be checked by means of a hand counter, which must be applied to the testing spindle at the side of the tachometer. It is highly desirable that the turbine should not run above or below the speed for which it is designed, as any deviation from the correct speed may affect the steam consumption considerably.

While speaking of speed, further reference should be made to the emergency governor. As already stated, the emergency governor is set to cut the steam off at a certain point, and although it is perfectly safe for the turbine to reach this particular point, it is important that it should not be exceeded. The emergency governor should therefore be tested at fairly frequent intervals to make sure that it is in order. The most convenient time for doing this is generally when the dynamo has just been taken off load ; the speed may then be gradually brought up until the emergency valve closes, thus shutting the turbine down. This done, say, once a week will not only keep the gear free, but should also relieve the engineer of unnecessary anxiety.

Emergency governors fitted to the Parsons turbines are of two kinds, viz., those actuated by means of the ordinary centrifugal flyball and those of the inertia type. As regards reliability and general satisfactory conduct, I

think most engineers will agree that the former is the more satisfactory, for once the correct compression is given to the controlling spring there is very little fear of the valve closing except when the speed reaches the limit. If any trouble is experienced with this type, it is generally that the valve closes late rather than early; this is generally due to one of the levers or rods working a little stiffly, or to some kind of obstruction caused, for instance, by lack of freedom in the dashpot or elsewhere, and a rapid inspection of the gear will generally reveal the trouble.

With the inertia governor, on the other hand, the cause of erratic conduct is not always so apparent, and engineers have been known to lose their temper when adjusting governors of this type. Their action is dependent on the inertia of a moving weight, which travels along a short spindle, and at a certain speed engages with a lever connected to the runaway valve, causing it to close. The adjustment is made by altering the compression of a small spiral spring behind the weight, the compression being varied by means of a nut which is, of course, locked.

It is surprising what a number of trials must be made sometimes before a satisfactory tension is arrived at. Of course, once the governor is set at the maker's works, there should be no need to interfere with it, but vibration often makes a considerable difference, and when the conditions of working are changed, it may be found necessary to readjust the emergency governor. For instance, when an armature has been changed, the machine should never be put on load before the speed limit has been tested, as the balance of the new armature may not be as good as that of the old, and it may be found that the vibration is sufficient to cause the governor to act much too soon. I have known governors on new machines to shut off exactly at the 10 per cent. when running without the generator, yet when the generator has been coupled up, normal speed could not be reached without the runaway valve closing. With a little study of these peculiarities, however, and frequent tests, the inertia governor will not be found unfaithful. Many turbines now at work are fitted with them, and although probably some engineers can tell of one unpleasant experience, they will, as a rule, sum up by saying that the governors are all right when you know them.

To describe the controlling governor of a Parsons turbine at any length would be a little wearisome; briefly, its action is as follows: — Steam is admitted to the turbine in puffs by means of a double-beat balanced valve, which is opened and closed at rapid intervals by means of a small relay piston, situated within a cylinder above the valve, the valve and piston being connected together by means of a spindle. On top of the relay piston is a spring which offers resistance to the piston being forced upwards by the steam admitted beneath. At the side of the relay cylinder is a small round plunger which is given a reciprocating motion by means of a lever driven from a cam. When the plunger is on the up stroke the steam is allowed to escape from beneath the piston, and the spring above forces the piston down, thus closing the main valve. When on the down stroke the exhaust is closed, hence the steam pressure beneath the piston rises, lifting it and the valve, so that by this small plunger working up and down the main valve is opened and closed, admitting and shutting off steam. The centrifugal governor itself is a spring-loaded bell-crank-armed governor without any special features, and is fitted with a regulating spring to adjust the speed. Its function is to alter the mean height of the rocking lever which imparts motion to the relay plunger, causing more steam to escape from under the relay as the load decreases, and preventing it from escaping as the load increases. It should be clearly understood that the relay plunger does not alter the admission of steam under the piston, but simply alters the exhaust; the admission is set, once for all, by means of a small valve at the side of the relay cylinder, through which steam is constantly admitted, but so slowly that it is only when the relay plunger closes the exhaust port that the pressure is sufficient to lift the piston and open the main double-beat valve. The obvious result of this arrangement is to alter the duration of the puffs of steam admitted to the turbine, as the number of puffs, of course, remains unaltered with varying loads. When running condensing, the exhaust steam from the relay cylinder is utilised in packing the neck glands, for if these are not packed with steam the condenser will draw air, resulting in a loss of vacuum. A word of warning is here again necessary. When starting up, the exhaust steam from the relay will not be found sufficient for this purpose, and before opening the main exhaust valve live steam should be admitted to the glands by means of the small valve provided for that purpose; when the steam is seen to appear at both glands the main exhaust may be opened. After the turbine has been put on load the relay will be found to supply sufficient steam to keep the glands packed, and the live steam valve may then be shut. When running there should always be a slight trace of steam coming from the glands, otherwise loss of vacuum will result, which is very undesirable with turbines. Another regulating cock is provided for transferring the steam from one gland to the other, should insufficient steam appear at one and too much at the other. A third valve is for allowing some of the exhaust steam to escape into the atmosphere at times of heavy load, when the relay exhausts a too liberal amount for packing the glands. When running non-condensing, the exhaust from the relay should be carried to the atmosphere with as little obstruction as possible.

Returning to the question of governing, it is well known that a 3 per cent. variation in speed from no load to full load, or *vice versâ*, should not be exceeded when the governor is in order. Sluggish working and hunting of the governor may be due to many things; among the most probable is sticking of the relay plunger, and when trouble is experienced with hunting or general unsatisfactory conduct on the part of the speed, this should first be looked to. The plunger should be carefully removed, and clamped in the vice by means of its iron head-piece, and then polished up with a piece of fine emery cloth. When this has been done it should be replaced, but not connected up to the rocking lever until it is felt to work perfectly freely. Should it still be found to bind, it should again be cleaned with emery cloth, applied mostly at the places where the binding is indicated. Great care should be exercised in removing this plunger, as it is made from a special metal having a very small expansion coefficient, which is extremely brittle; and if not warned, nine out of every ten fitters are almost sure to break it. The importance of being careful will be fully realised when it is remembered that the turbine is thrown out of action until a new plunger is obtained. If, after carrying out the above instructions, the speed is still unsteady, or otherwise unsatisfactory, all rods and other moving parts in connection with the governor should be tried for freedom. A rod slightly bent, for instance, by an accidental blow, will obviously upset the governing. Moving knuckle joints in rods should be tested for freedom by means of a feeler gauge, and a clearance of ·02 in. should in all cases be ensured. It is well to disconnect each of these moving joints and clean up the pins, and before connecting up again to make sure that the two rods meet each other without having to force one or the other to either side. Sticking or binding in the dash-pot must not be overlooked. When the governing gear is on the top of the turbine, as in the case of the old type, liquid dash-pots are fitted, and should be occasionally cleaned out and refilled with clean paraffin oil, or what other oil they previously contained. With the new types, especially in the large sizes, the dash-pots are dry, and are generally situated on the rotary pump spindle together with the governor itself. To test for freedom, the springs should be removed from the governor balls and the latter should be worked backwards and forwards by hand, and if felt to stick or bind, the dash-pot and other gear should be removed and cleaned or otherwise attended to, and should not be replaced until freedom has been ensured.

If trouble is still experienced, the relay cylinder should next be opened out. On removing the top-cover of the relay cylinder a metal cap and the spring already referred to will be found. These are simply lifted over the spindle and placed aside, when the piston can readily be removed. Before doing so, however, it is well first to try lifting the valve by means of the spindle, when any stiffness will generally be felt. The piston is held in position by means of two nuts on top, one of which is a lock nut, and when these have been removed, the piston may be lifted out by

screwing two pieces of screwed rod into the holes in the piston drilled and tapped for this purpose.

Beneath the piston will be found a brass bush which only projects through the bottom of the relay cylinder about $\frac{1}{8}$ in.; it is several inches long, and forms a distance piece between the bottom of the piston and the top of the valve. It is a loose fit on the valve spindle, but since it is at the bottom of the relay cylinder, and only projects a short distance, it is generally necessary to take the relay cylinder off the turbine altogether to get at it. This is a very simple job, as it simply means removing the few nuts round the bottom of the cylinder.

Having removed the relay cylinder, the bush referred to can be lifted off the valve spindle. The main double-beat valve is now in full view, and while this overhauling is going on it is well to remove it, and test it for being tight, and if not it should be ground up. The valve is held in position by means of four brass nuts, and to test it these should be removed, and the valve taken out and held in the vice. Small bolts should be placed through the holes in the top of the valve through which the holding-down studs pass when in position. These bolts should be provided with nuts, and should be pulled up tightly before the valve is filled with water for testing. If either of the seats is found to leak, it should be ground in with fine emery in the ordinary way, and the valve should not be replaced until perfectly tight, for, if it is leaky, this will clearly affect the governing. This done, the valve should be replaced, when the relay may be put together, not before, however, attending to one or two points; the chief of these is to make sure that the brass bush passes through the bottom of the relay cylinder perfectly freely. The amount of clearance generally allowed in the hole is ·01 in., which is, of course, plenty to ensure freedom if the bush and hole are devoid of obstruction. The brass bush should be cleaned by means of a piece of fine emery, likewise the hole through which it works. The relay piston should also be cleaned with a little paraffin, as well as the inside of the relay cylinder. When these points have been attended to and perfect ease in working is secured, the relay may be closed up again. When replacing the cover on the relay cylinder it is well to measure the compression on the relay spring, which in turbines manufactured by Messrs. C. A. Parsons & Co. is generally $\frac{1}{4}$ in. for all sizes. Having considered governor troubles at some length, we will now turn our attention to another point in connection with turbines which demands care on the part of all responsible for running them.

(*To be concluded.*)

REVIEWS.

The Care and Management of Electrical Machinery. Manchester: The Vulcan Boiler and General Insurance Co., Ltd. Price 1s. net.

The object of this little booklet, as explained in the preface, is to meet the want felt by power users, attendants and others for literature dealing with the equipment and care of electrical machinery, in language that can be understood by the layman. There is no doubt that much trouble has been caused through the utter lack of knowledge of unsophisticated attendants. As the average technical book is beyond their power of comprehension, the Vulcan Boiler and General Insurance Co. have attempted to fill the gap. The compilation of a satisfactory book of this nature is no easy matter. It is not difficult for a technical man to express his views before a technical audience, as there is a common groundwork of knowledge to build upon. To write a popular book on electrical matters is easy, because it is assumed that the reader has no technical knowledge whatever, and elementary matters only are dealt with in an elementary way. But in this book an intermediate class is appealed to.

A book of this nature should be written uniformly on the assumption that the reader has a definite though limited amount of previous knowledge. All matter with which the prospective reader is familiar, and all that is beyond his scope, should be omitted. It is to be hoped that in future editions of this booklet more attention will be paid to this point, and that the author will not place homely illustrations (which, to quote his own words, "may not be accepted as strictly accurate by electrical experts") side by side with a trigonometrical treatment of alternating-current theory.

The book shows traces of careless preparation; for example, on page 6 a watt is defined as "the unit of electrical work," and "is the work done in one second by a current of 1 ampere flowing with a pressure of 1 volt." In the following paragraph we read, "Power, it is important to note, is not work," so that the unsophisticated reader's views on the relations between power and work can more easily be imagined than described. Errors of this nature are quite inexcusable.

On page 11 the statement is made that "a wire moved upwards near the North Pole would produce a current in the same direction as a wire moved downwards near the South Pole." Now, if two isolated pieces of wire are meant, there will be no current produced whatever, and the E.M.F.'s that are induced will act in *opposite* directions. On the following page it is mentioned that if the wires are suitably inter-connected, the E.M.F.'s will assist each other in the closed circuit; but, nevertheless, the statement, as it stands, is ambiguous and misleading.

On page 12, two wires, A and B, are referred to, but as these are not depicted in any of the illustrations, one wonders why they are thus designated. An uninspiring picture of a field coil in fig. 5 is repeated in fig. 7 on the next page, and as the electros have been taken from the same block, the duplication hardly seems necessary.

Starting switches are now universally admitted to be a most important feature in a motor installation, but we protest against the statement on page 49 that "a poorly made motor will run satisfactorily when controlled by a good type of starter."

With the exception of the minimum and maximum release, a starter is not concerned with the operation of a motor when it has run up to speed. On page 50 we read that the starting switch is not designed to stop the motor. As most starters are required to cut the motor out of circuit when an overload comes on, we cannot understand what is the meaning of this remark.

Altogether we may say that the intentions of the author are good, but that his execution is bad; and we hope that in future editions the book will be completely remodelled and rewritten.

Cours de Physique de l'Ecole Polytechnique. By M. J. Jamin; third supplement by M. Bouty on Radiations. Electricity, Ionisation. Paris: Gauthier-Villars. 8 fr.

To the more advanced student of physics, the *Cours de Physique* has a secure place on his bookshelves. In many ways it is to be recommended. There is, for instance, a total absence of those long-winded algebraical proofs, which, in spite of cheap books in the calculus, still mar many a physics treatise. What is still more important, there are copious references to the original papers, so that students interested may pursue their studies *ad libitum*. The present volume is no exception, and the above remarks apply to it generally.

The first chapter deals with radiation from black bodies, and the pressure of radiation. Here the verification of Maxwell's prediction is discussed, Larmor's calculation and Lebedew's experiments being given. The experiments of Nichols, and Hull, and Poynting are also referred to.

Chapters II and III deal with emission from gases, limits of spectrum, Schumann's rays, N-rays, and dispersion.

Whatever may be thought about the N-rays of Blondlot in this country, it seems beyond all doubt that many of Blondlot's results have been confirmed by physicists in the front rank in France. The writer has attempted to repeat several of Blondlot's experiments, using a Nernst lamp as a source of N-rays, but without the slightest trace of success.

Chapter IV deals with Hertz waves and wireless telegraphy. With reference to the wireless telegraphy portion, it is stated that the wave emitted by an earthed antenna is a hemispherical Hertz wave, &c. This, of course, is orthodox theory; Dr. Erskine Murray has recently given an

entirely different explanation, and, in fact, regards "Hertz radiation" as *dead loss*. Others, again, hold that the earth does most of the signalling. The recent experiments of Marconi on selective signalling (*Phil. Trans.*, Royal Society, March 22nd, 1906) by means of horizontal conductors laid on the ground, seem to render an explanation by orthodox Hertz wave theory still more obscure.

Chapter V deals with magnetism and absorption of light in a magnetic field and the Zeeman effect. The remaining chapters dealing with Electrolysis, Radio-activity, Ionisation, study of sparking and Paschen's Laws, are very clearly written.

Chapter VI, on alternating currents, and XVII, on electrical instruments, seem to the reviewer altogether out of place in this treatise. In all other respects, we can heartily recommend this interesting volume to the notice of students.

The Practical Telephone Hand-Book. By J. Poole. London: Whittaker & Co. Third edition. Price 6s. net.

In no one of the electrical industries can it, perhaps, be said that more radical changes and advances are in progress, than in the art of telephony. This applies not only to methods of switching and schemes of distribution, but to type of plant used in the distribution, and to scientific investigation of the underlying principles of practical telephony.

A book on the latest phases of practical work by anyone so closely connected with the practical side of telephony as the author, is, therefore, to be welcomed. Although this is a third edition of a work first published in 1895, it is practically a new book, and can be treated as such, as it has been completely re-written and re-arranged to embrace the latest aspects of the art.

The amount of matter condensed within the work is surprisingly large as compared with the size of the book. Both theory and practice are covered in manner worthy of commendation, the illustrations being profuse and well prepared.

The history of the telephone is also briefly related in a terse and interesting manner. A specially interesting chapter is devoted to the history and development, told in brief, of the common battery system of telephony, imported into this country from America, and now making great headway against the old systems.

Most of the instruments and switches used either in magneto systems or common battery systems are fully described and illustrated. In addition to full descriptions of methods and appliances used for connections between subscribers in local areas, space is found for a brief but sufficient reference to the method of trunk line working adopted by the Post Office in their London Exchange, which may be taken as an up-to-date type of installation.

The latest development in the way of loading cables with inductance to increase their transmitting efficiency has also received a share of attention, and this chapter will no doubt prove to many to be the most interesting in the book. The type of elementary explanation of the theory which is given may not, however, appeal to the majority of practically minded electricians; but perhaps the same remark may apply to most, if not all, of the theoretical expositions of this question which have yet been published. If any serious criticism is to be offered on this chapter, it is, perhaps, in respect of the rather sweeping manner in which Prof. Pupin's work is disposed of. His chief discovery, according to the author, was in the nature of a mathematical formula. The chief value of Pupin's work surely lies in the clear way in which he has shown that the series arrangement of inductance coils in a cable rather than bridging coils, transformers, or leakage coils, reduces simultaneously both the attenuation and distortion of telephonic impulses. Such a series arrangement in virtue of the slowing down of the rate of propagation greatly reduces the C^2R losses in the line—a point which previous workers had apparently not fully recognised or had altogether overlooked.

In referring to the mutual capacity between the two wires of a twin pair in a cable, the author is careful to impress on the reader that, though it has been thought that the mutual capacity was about one-half that of a single wire to earth, recent measurements have revealed a higher value. This is a little surprising, for it has long been known, and is capable of easy mathematical proof, that it is only in the case of each wire being surrounded by a conducting earthed covering (and a submarine cable represents this type), that the mutual capacity is halved, and in these circumstances the halving is accurate. In any other case the mutual capacity is necessarily greater than half.

In a later chapter dealing with various measurements useful to the telephone engineer, mention is made of a method of measuring inductances by means of a buzzer and telephone. The author's statement that more accurate measurements can be obtained by this plan than by using the secohmmeter is questionable. The latter is, at least, definite in its measurements, and the former is indefinite, at any rate where iron-cored coils are to be measured. The whole subject of practical methods of inductance measurements is one that will bear careful investigation and overhaul.

We can, on the whole, thoroughly recommend this work to all who are in any way interested in the engineering aspect of telephony.

Electricity Meters. By C. H. W. Gerhardi. London: *Electrician* Printing and Publishing Co., Ltd. 1906 Price 9s. net.

In "Electricity Meters" Mr. C. H. W. Gerhardi has given us a valuable addition to the literature on this important subject.

He commences by giving a clear explanation of the units of work and energy, and his classification of meter types is good, the main divisions being—(1) Meters suitable for alternating currents only; (2) meters suitable for continuous currents only; (3) meters suitable for either alternating or continuous currents; (4) prepayment meters and double-tariff and maximum demand indicators. Each of these divisions is arranged alphabetically.

The descriptions and illustrations are good, and the author has criticised most of them in a manner which shows thorough acquaintance with the subject. In a large number of cases the drop in pressure due to the resistance of the series winding and the current in the shunt winding is given.

The choice of meters is discussed fully, and the author mentions a number of points which require consideration, but he lays too much stress on his statement that "a really good meter should have a 'curve' which is a straight line starting from the lowest load." A meter which has a curve similar to those obtained with most induction-type meters can be just as good as one with a straight line error curve.

The author does not consider the shunt losses to be of serious importance. It certainly is difficult to estimate quite what this loss costs, but that it is quite an appreciable amount there can be no doubt, particularly in the case of one of the meters described, which had a shunt loss of 20 watts at 200 volts pressure in the 50-ampere size.

Under certain circumstances, however, there can be no doubt that the very great reductions in the shunt losses which have been made recently are not so advantageous as appears on first consideration. The author goes on to describe a very complete testing room, giving a number of diagrams and illustrations. It certainly is an important part of a central station, and more attention should be given to it than is usual. For station engineers designing a test room, this chapter should be most useful.

Dealing with instruments, the author recommends the use of Kelvin balances and electrostatic voltmeters. In advising these latter, it has not been forgotten that for direct current it is necessary to take two readings, using a reversing switch. Whilst this is quite true, it is only of importance on low pressures, as the difference in the reading is only about 0·3 volt, which on a 200-volt circuit is quite negligible.

The frequency indicator designed by Mr. A. Campbell is described, but the later ones consisting of vibrating tongues are not mentioned. The measurement of time is dealt with, and the author lays special stress on the testing of stop-watches.

The testing of meters is dealt with carefully, and the real meaning of a percentage error is explained.

The last chapter deals with the keeping of meter books.

In conclusion, this book can be thoroughly recommended to every one interested in electricity meters.

ELECTRIC PUMPING AT COLLIERIES.

In a paper read before the Manchester Geological and Mining Society, Mr. Gerald H. I. Hooghwinkel generally discusses and describes some electrically-driven mine pumps. Probably of all colliery operations, that of pumping can best be dealt with electrically. As the author says:—"The disadvantages of steam as a direct motive power are obvious, if one only considers underground pumps and shaft sinking pumps with long and leaky steam ranges, obstructing the shaft to such an extent that shaft or pipe repairs become exceedingly difficult without stopping the pumps;" but it must be noted that it would be a difficult matter to repair even electrically-driven pump pipes without stopping the pumps. "These disadvantages, together with the high cost of steam installation and heavy repairs, have given the first impulse for the use of electricity in the underground workings of collieries." With regard, however, to the question of "heavy repairs," this, generally speaking, is exaggerated, as a well-designed heavy duty steam pump will run for years without costing a penny for repairs, and there are now working at many collieries in this country main pumps, both on the surface and underground, that are doing their work both economically from a steam consumption point of view, and without requiring "heavy repairs." In fact, there is no reason why this should not be so, as a pumping load is probably the easiest to deal with—being steady and constant—to obtain the highest efficiency. The trouble, however, is in conveying steam down the pit shaft to an underground pump, and where the water is bad, in obtaining efficient condensation, as with bad water the valves, pipes, &c., often become thickly incrusted, necessitating frequent stoppages for cleaning; for the steam from an underground steam pumping engine—except in cases of emergency—*must* be condensed.

These objections may be met by placing the pump on the surface, where the steam transmission may be very short, and if the water is not suitable for condensing purposes, water from an independent source may be obtained; but placing the pump on the surface means heavy expenditure in foundations, engine house, shaft work, &c., and a frequent source of trouble is the breaking of one of the "spears"—which are usually long pitchpine rods connecting the pump to the large bell cranks or "quadrants,"—serious damage being sometimes done to the engine. As before stated, however, with a well-designed pump, and efficient supervision, the steam pump does its work well, and we would not suggest changing over such a pump from steam to electrically-driven, unless other factors—such as, say, a bulk supply of energy at a cheap rate from an electric supply company—or conditions, rendered it advisable to do so.

Speaking of pumps, the author says "the only types of pumps available until recently were slow speed ram, piston or bucket pumps, according to the lift required; but on account of the shorter strokes and smaller masses to be moved, underground direct-driven steam pumps were worked at higher speeds than surface pumps. However, even these comparatively low speeds were not very suitable for coupling to electric motors without the use of gearing. As gearing was thought to be objectionable by most mining engineers, a prejudice not shared by the writer, the electrical engineer was asked to reduce the speed of his motor to such a point that two of the great advantages of electric motors, namely, cheapness and small dimensions, disappeared." The only objections the mining engineer has to gearing are its liability to break, and the fact that most colliery steam pumps being of the slow speed type, gearing is not required, but there is certainly not the rooted objection the author seems to imply, as is evidenced by the great number of three-throw geared electric motor-driven pumps now working. "The desire to use moderately high speed motors resulted in the design of high speed pumps, such as the Riedler, the Bergman, and several others, using mechanically-aided valves, operated by levers, cams or eccentrics." The main advantage of these pumps, from a colliery point of view, was that they occupied only a small space, and would deal with a large quantity of water. Experience, however, has not justified their adoption, owing to very serious valve troubles. The author then describes the Sulzer and Rateau centrifugal pumps, and states that "the commercial construction of high-pressure centrifugal pumps is of recent date, and is due almost entirely to Messrs. Sulzer Brothers, of Winterthur." It should not be forgotten, however, that John Gwynne took out a patent for this type of pump in 1851, and that Messrs. Gwynnes, Ltd., now make centrifugal pumps to deal with 4,000 gallons per minute against a head of 1,000 ft. in a single lift; but probably the most singular claim put forward by the author in favour of the centrifugal pump is: "The water pumped from its proper inflow level is also much clearer, and has, therefore, a certain value when brought to the surface." We are at a loss to see how dirty pit water can be made clean by merely passing it through a centrifugal pump.

Dealing with sinking pumps, the author says:—"In this case large quantities of sand and other impurities have to be lifted by the pump, which would destroy the ordinary high speed ram pump with metal valves in no time, while the slow-speed rod-driven pump fitted with leather or rubber valves is not much damaged by the sand . . . . The introduction of the high-pressure centrifugal pump with its simplicity, small dimensions, lightness, and high speed, has altered the case, and the writer contends that an electrically-driven centrifugal pump is unrivalled for sinking purposes on all points."

As to efficiency, the author says:—"A practical average value for an electric pumping plant of medium size calculated by the writer from observations of 15 large electric plants is 65 per cent. from the steam side of the main engine to the water raised by the pump. This represents from 16 to 18 lb. of steam per H.P.-hour of useful load, an efficiency which is not often reached with steam pumps. The individual efficiencies of the different sections of the machinery have been determined, and also constitute a fair average taken over a number of installations, namely, engines, 88 per cent.; dynamos, 93 per cent.; cable, 97 per cent.; motor, 90 per cent.; and pump, 86 per cent. The efficiency of the Express pump is the highest, rising to 95 per cent." . . . . Others show from 90 to 92 per cent. of efficiency. Centrifugal pumps have a lower efficiency, about 75 per cent. for Sulzer-type pumps and 80 per cent. for Rateau-type pumps.

On the whole, the paper is too general to be of much value, and would have been much better had the author given sectional drawings and entered into a little more detail in his descriptions of the various types of pumps, and what the mining engineer most delights in—some particulars of actual costs.

ELECTROLYTIC MANUFACTURE OF SODIUM HYPOCHLORITE.

A paper on the "Application of Electrolytic Chlorine to Textile Bleaching" was read a short time ago by Mr. H. S. Duckworth before the New England section of the Society of Chemical Industry, and is printed in the *Journal*. The paper is taken up with a description of the Haas-Oettel apparatus for electrolysing brine, which has been in use at the works of the Cocheco Manufacturing Co. for nearly three years. The plant consists of a cell made of "asphalte composition," placed within an insulated water-tight tank. The cell contains a plate of carbon at each end, $\frac{3}{4}$ in. thick, standing vertically, and connected with the source of current. Transversely the cell is divided into a number of compartments by means of carbon plates $\frac{3}{8}$ in. thick, which act as intermediate electrodes. The main electrodes reach to the bottom of the cell, but the intermediate plates rest upon a non-conducting plate underneath, and support a second non-conducting plate above them. These cells are entirely submerged in liquid when the outer vessel is fully charged, but are each provided with an aperture at the base and at the top for the circulation of the electrolyte. As the electrodes are covered with liquor, the chlorine evolved during the passage of the current has to pass through this liquor; it is, therefore, absorbed, and no odour of chlorine is produced in the room where the apparatus is at work. The liberation of hydrogen in each cell causes the liquid to be carried upwards until it has a head above the liquid in the outer vessel, and thus there is a constant circulation between tank and cells through the two holes in each of the latter. The separate cells also serve to collect dirt and impurities, preventing them from establishing short circuits. A thermometer in one of the cells enables the temperature to be kept at, or below, 28° C.; and a cross-over switch is provided so that the current can be sent backwards through the plant after every fresh charge is inserted, to remove the slight deposit of calcium and magnesium salts upon the carbon plates. The current is direct at 110 volts, and is obtained from the lighting mains.

With this apparatus it is possible to make in 5·5 hours 126 (U.S.) gallons of sodium hypochlorite solution containing 14·4 grammes of chlorine per litre, *i.e.*, 6·86 kg., or 15·12 lb., of chlorine. This chlorine is equal to 45·36 lb. of 35 per cent. bleaching powder, allowing 8 per cent. for loss in bringing the latter into solution. As, however, electrolytic chlorine is more efficient than the chemically prepared gas—3 lb. of electrolytic chlorine being said to be equal to 4 lb. of chlorine from bleaching powder—the 15·12 lb. of combined chlorine obtained may be considered the equivalent of 60·5 lb. of bleaching powder. The consumption of power in the process is 64 amperes at 110 volts, *i.e.*, 58 H.P.-hours in the 5·5 hours mentioned. Taking the H.P.-year at $15 (water-power basis), and salt at $6.10 per ton delivered, of which 159 lb. are consumed in the time stated, the cost of the 15·12 lb. of chlorine comes to 51·54 cents for material plus 27·84 cents for energy—a total of 79·38 cents. The equivalent cost of 60·5 lb. of bleaching powder at 1·25 cents per lb. plus 7 cents for freight comes to 82·60 cents. If the electrical energy is generated from coal and costs $25 per H.P.-year, the cost of the above-mentioned amount of energy comes to 46·40 cents, so that the 15·12 lb. of chlorine cost 97·94 cents altogether. The unit of time selected is the one which is usually worked, and it allows of two runs being made per day of 12 hours, and one run on Saturdays.

The practical advantages claimed on behalf of sodium hypochlorite in comparison with calcium hypochlorite as a bleaching material are:—The former can be employed in a nascent state. It is quicker and more energetic in its action. The whites obtained on the fabrics are purer and more permanent. The bleached goods are stronger, and have a better "feel." If subsequently dyed, they

take the dye better and more evenly. Less acid is required after "chemicking." The whites of printed goods are more easily cleared. The whole process of bleaching is much cleaner and vastly more satisfactory.

It is believed that the process is particularly suitable for use on the small scale. An apparatus for making some 6 lb. of chlorine per day occupies only a few square feet of floor space, and is constructed by the proprietors of the patents entirely of porcelain for employment in laundries and similar places where bleaching is frequently required.

In the course of the discussion upon Mr. Duckworth's paper, it was urged that there could not be any difference in bleaching efficiency between a certain quantity of hypochlorite chlorine combined as the calcium salt and the equivalent quantity as sodium hypochlorite; but, in reply to this, Dr. W. H. Walker stated that such an assumption was a confusion of chemical with bleaching power. Solutions containing equal amounts of available chlorine might behave differently as bleaching agents because they were hydrolysed to a different extent, or because one contained more carbonic acid than the other. Calcium hypochlorite solution made from bleaching powder is saturated with lime, and the latter reduces its bleaching power; moreover, it combines with any carbonic acid, preventing the gas from acting upon the saline compound, so as to evolve free hypochlorous acid, which is the most efficacious bleaching compound of the whole series.

AMERICAN TELEPHONES AND TELEGRAPHS IN 1902.

Special reports have just been issued by the Department of Commerce and Labour Bureau of the Census, Washington, in a style which might well be followed by our own Government, the type, paper and binding all being excellent. The reports deal with the telephone and telegraph systems, and the municipal electric fire alarm and police patrol systems of the United States. Mr. A. V. Abbott is responsible for the telephone portion, and Mr. W. Maver, jun., for the telegraph portion.

Mr. Thomas Commerford Martin, expert special agent at New York, in dealing with the telephonic system, states that owing to the vast strides of telephony in the United States, telegraphy has been regarded by many authorities as being in a condition of arrested development, and that the introduction of wireless telegraphy is likely to have a marked effect upon the growth of the industry. Be this as it may, it is our opinion that the new means of communication has, so far, not reduced the value of cables or telegraph lines for commercial purposes.

It is only necessary to cast a glance over the telegraph map, and it will be found that within the last few years thousands of miles of new submarine cables have been laid, and that new lines, either submarine or landlines, are still being contemplated. It is true, of course, many islands have been connected by wireless, but it is doubtful, in most cases, if a cable would ever have been laid to them. However, we do not desire here to discuss the merits or demerits of wireless telegraphy, but merely to show that it has in no way so far substituted existing cables efficiently maintained.

There are 4,151 telephonic systems in the United States with 4,850,486 miles of wire. There are 14,124 officials drawing salaries, amounting to $9,885,886 (£1,977,177), and 64,628 wage-earners being paid $26,369,735 (£5,273,947). The capital value of the system is $348,031,058 (£69,606,211). The yearly revenue of the system is $86,825,536 (£17,365,107), and there was a net surplus in hand of $6,678,046 (£1,325,609). The mileage of wire includes the Western Union Telegraph system outside the United States, but not 16,677 nautical miles of cable operated by submarine cable systems, nor telegraph and telephone lines owned by steam and electric railway companies and operated along their tracks for service purposes.

In 1902 the telephone systems operated 78·6 per cent. of the wire mileage reported for both telephones and telegraphs, gave employment to 70·7 per cent. of the wage-earners, received 68 per cent. of the total revenue, and paid 67·8 per cent. of the total expenses.

On examining figures of the telegraph systems, it is found that 25 exist, equalling 1,318,350 miles of wire, the Western Union cables not being included, nor the railway service lines. In this service there are 829 salaried officials, drawing $1,162,632 (£232,526), and 26,798 wage-earners, drawing $13,877,041 (£2,775,408). The capital outlay is $162,946,525 (£32,589,305), the revenue $40,930,038 (£8,186,007), operating expenses and other charges except interest on bonds $28,998,884 (£5,797,777), and the net surplus is $3,725,311 (£745,062).

It is interesting to note the great progress of the telephone system in the United States, and the following figures will prove the gigantic strides it has made. In 1880 the population was 50,155,783, and the number of telephones 54,319, being an average of 923 persons to every telephone. In 1902 the population had increased to an estimated 78,576,436, and the telephones to 2,315,297, being an average of about 34 persons per telephone. The total number of subscribers in 1902 was 2,178,366. Further, exchanges increased from 437 to 10,361, the number of employés from 3,338 to 78,752, and the revenue from $3,098,081 (£619,616) to $86,825,536 (£17,345,107). Capital stock also increased from $17,386,700 (£3,477,340) to $384,534,066 (£76,906,813).

Various summaries were received from Alaska, Philippines and Hawaii, but they are not included in the above figures.

The following figures will show the vastness of the "Bell" telephone system (American Telephone and Telegraph Co.). They own 3,387,924 miles of wire, 1,222,327 subscribers and 56,405 officials and wage-earners, and they deal with 3,074,530,060 conversations out of a total of 5,070,554,553.

Tables are given dividing and comparing figures for each State, under the heads of commercial, mutual, rural, independent, &c., and altogether the amount of labour involved in the task of compiling the various records published must have been enormous, and great difficulty must have been experienced in grouping results. It appears that American telegraph and telephone companies have no leaning towards preferred stock, for out of the total of stock outstanding, $510,977,583 (£102,195,516), only $6,069,621 or £1,213.924, is preferred.

143 of the commercial systems reported a deficit amounting to $8,147,938 (£1,629,587).

$51,903,021 (£10,380,604) was expended during 1902 in new construction, and if this rate of growth continues, the investment values in the telephone industry will have more than doubled by 1912.

New constructions were largest in New York, which leads with $7,566,365 (£1,513,273), then follows Pennsylvania with $6,114,696 (£1,222,939), and Illinois with $4,472,060 (£894,412).

Real estate is now being largely purchased by the telephone systems, on which they build their own offices, whereas formerly rooms in the upper storeys were rented. Assets under this head amounted to $22,716,538 (£4,543,307), whereas for rent of offices and real estate the annual payment was $2,498,814 (£497,762), while $1,348,894 (£269,779) was received on this account.

The report further states that the general reservation for depreciation and reserve appears to be inadequate, especially in view of the necessity for frequent and entire reconstruction of lines and exchanges on account of the growth of the industry and the changes in the methods of operation. An instance is quoted of a company in Baltimore whose entire original plant, after being in service but five years, was disposed of as "junk," and $2,155,000 (£431,000) was spent in its replacement.

The Merchants' Association of New York, in a report dated June, 1905, stated: "In the New York telephone system improvements and changes have succeeded one another at close intervals during the entire period in which the business of exchange telephone service has existed. During the 16 years which the committee's investigation covers, the plant had been practically rebuilt three times. At various times radical improvements have been made in cables and in switchboard systems, which have involved the abandonment of plant by no means unserviceable, because of its physical condition and its replacement by plant of an improved character. Some of the central stations have been rebuilt three times within a little over 10 years."

These changes are not peculiar to New York, and must occur all over the country and it would seem that the percentages of dividend payments and of reserve might well be reversed. The committee further stated that to provide a fair return of capital actually and necessarily invested, and a proper allowance for contingencies, 10 per cent. margin above operating outlays is a reasonable and proper margin in the telephone business.

New York State was by far the most productive as to revenue, having given $16,352,193 (£3,270,438), or 18·8 per cent. of the total, while the operating expenses and fixed charges were large, amounting to $10,933,934 (£2,186,787), or 16·7 per cent. of the total. Next in magnitude was Pennsylvania with a revenue of $8,083,896 (£1,616,779), and expenses of $6,315,052 (£1,263,010); Illinois with a revenue of $7,308,885 (£1,461,777), and expenses $5,537,793 (£1,107,558). These three States and Ohio, Massachusetts and California accounted for $48,156,142 (£9,631,228), or more than half of the revenue and $35,843,159 (£7,168,631), or more than half of the expenses.

Some difficulty is experienced in estimating traffic. It has been a custom with most of the telephone companies to make an actual count of the messages handled by each of the offices during a period of 24 hours once each month. The probable yearly business is computed from the statistics thus obtained by multiplying the average of the various monthly counts by the number of days in the year, allowances being made for holidays. Some companies do not count or report the number of conversations, and it seems probable that the number of messages indicated in the tables is slightly under-estimated.

The distribution of telephones, the use of each instrument, and the number of messages *per capita*, do not depend solely upon density of population. Other factors, such as the kind of population, the prevailing nature of the industries, and the assiduity with which the telephonic habit has been cultivated by the managers of the companies supplying service, constitute potent agencies in varying the number of instruments installed and the use to which each is put. The most powerful influence is the tariff charged. California was one of the earliest States to be served upon a measured service basis, and so this method of charging was vigorously pushed; the result was that this State had the largest number of telephones in proportion to its population, there being a telephone for every 14 inhabitants. As a result of the low rates, the number of messages *per capita* was high in California, Ohio alone outranking it in this respect. Ohio exceeded California in population per telephone, with 19 inhabitants per instrument. San Francisco, in 1902, was ahead of all other towns, with a telephone station for every nine inhabitants; New Orleans having one for every 41, and New York one for every 39.

In regard to the relation of traffic to earnings and expenses, it is stated that when the cost to the subscriber is based upon some form of measured service, the volume of business is a more or less direct measure of the revenue of the company, and of its cost of

operation. The operation of any form of metered service tends to reduce the amount of traffic; for if subscribers are charged by the message, they invariably economise as much as practicable. If the charge for the traffic is at a flat rate, the company's revenue depends upon the number of instruments installed, and not upon the volume of traffic, while the expenses are measured more nearly by the number of messages transmitted. With a flat rate service there is no tendency toward economy on the part of the subscriber, for knowing that his telephone charges are represented by a fixed annual sum, he and his friends use the instrument liberally.

When counting traffic, usually each operator is provided with a wooden peg about the size of the ordinary plug, and is instructed to use the set of 100 multiple jacks nearest in front of her. Commencing at midnight, all operators insert these pegs in the zero jacks of the banks, and then each operator moves the peg along one jack for every call that is received. At the end of each hour a clerk makes a memorandum of the number of the jack in which each peg stands and removes the peg to the zero jack, thus making a record of the number of calls each operator has answered. If lines are supplied with a message meter located in the exchange, an hourly inspection of each meter is all that is required. Several pages of this exhaustive report deal with the instruments in use, and illustrations are given showing them as a whole and in parts.

Chestnut poles are largely used in the States of the North Atlantic and North Central divisions, and in those of the South Atlantic and South Central divisions, juniper, cypress, cedar and sometimes southern pine are employed, although the pine and cypress rot so rapidly as to make the maintenance of such poles an expensive item. In States of the Western division the various kinds of pine and fir imported from the North Pacific coast prevail. Cross-arms are usually made of yellow pine, and range from 3 ft. to 10 ft. in length.

The invention of the so-called paper cable has completely revolutionised the building of telephone lines by providing a method whereby, at small cost, a large number of conductors can be compressed into a small space. The manufacture of these cables and the construction of conduits, occupies two pages of the report, and is accompanied by illustrations. Another chapter deals with exchanges, and six pages are devoted to this, with various illustrations.

Employés.—While women have found a limited employment in telegraphy, the art in this country has remained practically in the hands of men.

On the other hand, telephony has provided for a large number of young girls employment at a low rate of pay, comparing in this respect with the factory system. Of the operators, 37,333 were women, and only 2,525 were men, the former being paid $10,035,432 (£2,007,086), and the latter, $729,666 (£145,933). The night work at many of the exchanges is performed by men at a higher rate, and therefore there appears a slight difference in favour of their incomes. For many years it has been recognised that operators' work in telephone exchanges attracts a superior class of women. It has been demonstrated beyond all doubt that the work of operating is better handled by women than by men or boys, and that trained and well-bred women operators perform the most satisfactory service. This has resulted in gathering into the exchanges throughout the country young women above the average in ability and ambition.

From an early day the telephone companies in the United States have been alive to the importance of securing and retaining this quality of labour, and have appreciated the desirability of providing something more than the required salaries. As long as 20 years ago, in exchanges in large cities, comfortable rest and retiring rooms were provided, and also some portions of a luncheon, all properly supervised by a matron. Latterly, in many exchanges, the companies have undertaken to furnish the entire lunch and to sell it at cost to the operators, while in at least two of the larger cities the companies have for several years being furnishing the lunch entirely at their own cost. The effect on a large working force of providing ample cloak room facilities, with well-ventilated lockers, good rest and reading rooms, and a hearty meal, has been apparent in the better health of the operators employed.

In many other ways the operators are looked after by being assisted in the matter of libraries, lectures, gardens, and they are also given a premium for each applicant recommended who remains in the operating training school a period of two weeks. An additional sum is paid when the applicant has graduated and has remained on the operating force three months.

Chapter X deals with rates and their history, and covers 12 pages, and this is followed by Chapter XI, dealing with the history and development of telephony. Chapter XII deals with telephony in foreign countries and comparisons are drawn between the United States and Europe in various ways, all showing the superiority of the former. It is found that the whole of Europe owns 8,485,784 telephones, against 3,400,000 in the United States. The United Kingdom, with 42,000,000 inhabitants, *i.e.*, more than half of those living in the States, numbering 76,000,000, possessed only 365,198 telephones! Here again 11 pages are filled with matter, which should set all Europe thinking of ways and means of bettering a system which, for facilitating business, is nowadays thought indispensable.

Telegraphs.—As the last statistics compiled in 1880 did not include the domestic ocean cable systems, the figures for 1902 cannot properly be compared with them, and so we shall content ourselves by quoting the latter. There were in 1902 25 systems with 1,318,350 miles of wire (exclusive of 16,677 nautical miles of submarine cable). 91,655,287 messages were dealt with, 820,498 thereof being cable messages. Receipts amounted to $29,118,089 (£5,823,619). Telegraph offices numbered 27,377, and wage-earners and officials 27,627. The salaries and wages amounted to $15,039,673 (£3,007,934). The outstanding capital amounted to $117,053,525 (£23,410,705). Revenue from traffic and other sources amounted to $40,930,038 (£8,186,007), and expenses to $37,204,727 (£7,440,945), the surplus being $3,725,311 (£745,062). The assets were calculated to be $195,503,775 (£39,100,755). It will be noticed that all these totals are exceeded by the figures reported for the telephone service, and the authorities while admitting future progress of the telegraphs, believe the disparity between the totals will grow wider every year. It appears, however, that here again difficulties are encountered in ascertaining the number of messages, owing to the difficulty which a company, owning both a land and ocean business, has in separating cable and other messages. It is stated also that the competition of the telephones has kept down the use of the telegraph. The rates of the two systems for medium distances do not differ greatly, and for every long distances they are overwhelmingly in favour of the telegraph, if the message be taken as the unit; but if the number of words exchanged be taken into account, as well as the time required for getting into communication, the telegraph is at a disadvantage, in case of a large amount of traffic. Frequently the brief message will suffice, and the written telegraph serves as a record, but where a swift interchange is required, the telephone seems to have thoroughly established its superiority. The public employs the telegraph at the rate of only a little more than once a year *per capita*, whereas the number of telephone messages is already 65 *per capita*. Seven of the 25 telegraph systems reported an expenditure of $4,776,763 (£955,352) for the year. Of the total length of wire, 1,307,046 miles, 1 234,394 miles were owned, and the remainder leased. Of the owned wire, 1,216,450 miles, or 98·5 per cent. was overhead; 17,265 miles, or 1·4 per cent. was underground, and 679 miles, or ·1 per cent. was in submarine cable.

Owing to the complicated nature of the Press business, it has been impossible to arrive at any figures, but it is said that the British figures of 14,588,458 words per week are known to be far below the American figure.

The District Messenger service of about 50 companies operating in about 1,000 of the most important cities has been acquired by the American District Telegraph Co., of New Jersey. This company, however, do not yet operate in New York, and they have a contract with the Western Union Telegraph Co. for the delivery and collection of messages. All message collection and delivery business of the Western Union Co. in New York City is handled by the local American District Messenger Co., which possesses 85 offices, 29,143 instruments, and 1,200 messengers. It is also stated that the Postal Telegraph Cable Co. has organised a number of district messenger companies to render services similar to the above, but no figures were collected in regard to them. It has been stated by one of the presidents of the Western Union Telegraph Co. that 46 per cent. of messages transmitted referred to speculation of some kind.

The report demonstrates the great usefulness of the signal corps, which has maintained and provided telegraphic facilities in Alaska and the Philippines in a very satisfactory manner.

The service owns two cable-repairing steamers the *Burnside*, which has been largely used in Alaska and the Philippines, and the *Cyrus W. Field*, which is used chiefly on the Atlantic coast, owing to the difficulty in obtaining company ships to repair Government cables to some of the most important defences of the United States. Other work of a telegraphic nature under the management of the Signal Corps comprises the operation of the telegraph and cipher bureau of the White House, which places the Commander-in-Chief of the Army and Navy in quick and direct communication with the military and naval forces of the United States.

Weather Bureaux.—Extensive work is carried on in this direction, there being no fewer than 2,015 places in the United States receiving daily forecasts; 926 were in receipt of special warnings, and 7,096 of emergency warnings. All this work is done at the expense of the Government. The forecasts, besides being issued free to agriculturists and others, are distributed by telegraph and telephone, and are also published in 2,500 daily newspapers. In the middle Western States, from Ohio to Nebraska, 606,000 farmers obtain the morning weather forecasts by telephone 30 minutes after they are issued. The total cost of the weather bureaux is about $1,400,000 (£280,000) per annum, and it is estimated the annual saving to the people of the United States is, after careful investigation by an American insurance company, $30,000,000 (£6,000,000).

In 45 minutes after the determination of a storm warning at Washington it is brought to the notice or placed in the hands of every sea captain in every lake and ocean port of the United States.

This report concludes with a chapter on municipal electric fire alarm and police patrol systems, and a short history of the development of telegraphy. The book forms most interesting reading, being in this respect different from the majority of reports, which the public generally look upon as being as "dry as dust." We think the compilers of this report are to be congratulated.

Bradford Electric Tramways.—After years of controversy as to the charge which should be made by the Electricity Committee to the Tramway Committee for electricity supplied to the tramways, it has now been agreed that for the five years from April 1st, 1906, the charge shall be 1½d. per unit instead of 1d. as heretofore. This will increase the cost of electricity for the tramways from about £35,000 to £40,000.

THE FUTURE REGIME OF ELECTRICITY IN PARIS.

Paris finds herself to-day in a most awkward situation with regard to the supply and distribution of electrical energy. The position may be stated as follows :—At present the city is supplied with electricity by six independent companies, called the six Sectors, who received various concessions from the municipal authorities for the carrying on of this work. These concessions are about to expire, some in 1907 and some in the beginning of 1908, so that the Council must decide very quickly what action it shall take to ensure a uniform and economical supply. The trouble is that while, on the expiration of the concessions, the distributing network will revert to the town, neither the power stations, sub-stations, nor any of the feeder cables will go with it. Thus Paris may find herself, in a few months, in the unenviable position of owning a large network, but no generating or feeding plant.

What is to be done? That is the question of the hour in Paris.

There are two main schemes in existence, namely, the scheme of MM. Schneider & Mildé, and that of a society called "The Parisian Society for the Distribution of Electricity," the latter being simply an association formed from members of the Sectors. The relative values of the two schemes may be best judged by a comparison given in a communication by the Prefect of the Seine to the Municipal Council. This official states that both schemes are of a transitional nature, designed to bridge over a period of time between the expiration of the concessions to the Sectors and a date when the town will be able to take up the whole supply and distribution for itself. The project of the Sectors (let us call this No. 1) provides for the supply and distribution of energy until December 31st, 1928, at the end of which time the town will enter into possession of the old and new networks; the project Schneider-Mildé (No. 2) supplies energy until the end of 1938, at which time the town will enter into possession of the whole outfit, network, power stations, sub-stations, &c.

There is an equivalence of financial value, as nearly as can be calculated, between the two schemes; but in the opinion of the Prefect No. 1 would be less satisfying to the public generally, inasmuch as all consumers' repairs, &c., must be done by the Society of the Sectors, even though the consumers are themselves the owners of the plant on their premises; again, No. 2 guarantees at least 400 km. of new network, while No. 1 guarantees only 300 km., and most important of all, the Sectors stipulate that they shall not be obliged to erect power and sub-stations, but that they may obtain their electricity where they will. There seems to be a want of cohesion in No. 1 scheme that will most likely cause its rejection.

Both these projects, along with several others which allow of a five years' transitional period, are based on the instalment system, and are likely to give as much satisfaction as one expects to get from the purchase of anything in this manner.

Many people urge that the town should buy outright the power stations and plant belonging to the Sectors. There is against this the fact that the different Sector companies use various methods of distribution and various voltages, while their machinery is getting out of date, and will soon become obsolete. Furthermore, the generating plant of the Sector companies is already inadequate and will certainly become, in the near future, much too small for growing Paris.

A scheme that has been proposed, and has attracted great attention, is the project of transmitting electrical energy from the Rhone. The water would be taken from the river in the neighbourhood of Bellegarde. The power obtainable at times of low water would be at least 80,000 H.P., but would reach, by means of a large reservoir, 180,000 H.P. during the five hours when the consumption is at a maximum. The current would be brought to Paris by two lines, forming a loop 450 km. in length, the pressure between these lines attaining 130,000 volts at the moment of maximum load. On arrival, half the high pressure direct current would be transformed into three-phase current in a power house situated at Charenton or Ivry, and half into low pressure direct current in a second power house installed in the heart of Paris.

The principal objections to this scheme are as follows :—

1. Considerable lapse of time before realisation of the project.
2. Important loss of energy on the line.
3. Unaccustomed length of transmission line.
4. Want of reliability of supply.

In stating these objections we leave aside altogether those of a technical nature. Such a transmission does not present to-day serious technical difficulties, and pressures of 65,000 volts between line and earth, with direct current, are no longer remarkable.

The difficulty regarding the want of reliability of service is more serious, and this drawback is but little affected by the fact that the project provides two distinct lines following different paths for the going and coming of the current—for they are in series. The most important objection is the long time necessary to carry out the project, the estimates varying from 4 to 10 years.

Meanwhile, the Municipal Council can come to no conclusion. The Sectors whose concessions are expiring are making valiant efforts to effect a compromise. Many of their arguments are good, but several are quite unacceptable.

THE SOUTH SHIELDS ELECTRIC TRAMWAYS.

The question of the tramways in this Tyneside borough absorbed a large amount of attention locally, until it was definitely decided that the Corporation should both construct and work a scheme of its own.

The provisional order under which the tramways have been constructed was obtained in 1903, but it was not until the early part of last year that a definite decision was arrived at. The actual work of construction was commenced in June, 1905. Some delay was caused by the fact that up to the end of February, 1905, the town was served by horse cars, which prevented the old lines from being interfered with until the expiry of the lease. So soon as the lease had expired, however, the work of pulling up the old lines and preparing a way for the electric tramways was commenced and carried forward expeditiously. Meanwhile the new routes had been in course of construction, so that generally good headway had been made; altogether some 6½ miles will eventually be open for traffic. The routes are, in the main, double track, and are constructed on the overhead trolley principle. Except in the way of what may be called street improvements, the work of construction has not been attended by any exceptional difficulty; the steepest gradient in the whole system is 1 in 16, and this only occurs for a short distance.

The total cost, inclusive of street improvements and land, may be approximately put down at £140,000. The constructional work was carried out by Messrs. Underwood & Brother (permanent way work and bonding), and Messrs. Dick, Kerr & Co., Ltd. (overhead equipment). Mr. J. H Cawthra, the borough electrical engineer, was responsible for the whole of the electrical equipment.

The rails are of British Standard Section Nos. 2 and 2c. Those used on straight track work weigh 95 lb. per yd., and on curves 101 lb. per yd. The rails are laid to the 4 ft. 8½ in. gauge, each joint being anchored by means of rolled steel joists, each 24 in. × 8 in. × 7 in.; in addition to these there are holding-down bolts with cast-steel disks 7 in. dia., pitched every 6 ft., the whole being embedded in concrete. The points, crossings, and other special work are of manganese steel, and have been supplied by Messrs. Hadfield. In the electrical equipment of the track, 12-in. protected bonds of the Forest City Electrical Co.'s manufacture have been used, two at each joint, with cross bonds of 0000 B. and S. gauge inserted every 160 ft. approximately, and intertrack bonds of the same size, placed every 240 ft. approximately, bridging bonds being used at all points and crossings.

The overhead construction is chiefly on the side bracket principle; two grades of poles are used, except at one or two curves where an extra heavy pole is used to take the severe strain. Grooved trolley wire of hard drawn copper No. 000 B. and S. wire gauge is used throughout, and is mechanically clamped up by the ears, no solder being used. On straight runs these ears are 18 in. long, and on curves 24 in.

The car depôt is capable of housing 40 cars, and is built on the most approved principle. It consists of a main brick building, with workshop, paint shop and offices adjoining. There are eight tracks in the main building, and each has an inspection pit running almost the entire length. Kinnear steel revolving shutters, with patent trolley-wire attachments, are provided at the entrances. The depôt was built by Messrs. Arnold, of Doncaster. The cars are of the double-deck type, and were constructed by Messrs. Hurst, Nelson & Co., Ltd., with the British Westinghouse Co. as sub-contractors for the equipments. The cars are 29 ft. in extreme length, and 7 ft. wide, with open staircases and garden-type seats both inside and out. The trucks are of the Brill type, the wheel base being 6 ft. 6 in.; the wheels, steel tired, are 30 in. dia. Each truck is fitted with two 30-H.P. motors and both hand and electric

brakes are provided. The cars have each seating accommodation for 58 persons.

Energy for the system is drawn from the Corporation Electricity Works which have been extended to provide for the new demand to be made upon them. In the boiler house one marine boiler has been added to the five already in position. This boiler is 14 ft. 6 in. external diameter, by 10 ft. 6 in. long, and has a heating space of about 2,000 sq. ft.; the working steam pressure is 165 lb. per sq. in. The generating plant consists of two 550-KW. direct-current traction generators, made by Messrs. Dick, Kerr & Co., Ltd., direct-coupled to triple-expansion marine engines, and running at 150 r.p.m. The generators each have an output of 1,000 amperes at 550 volts, and are compounded to give a rise of 50 volts between no load and full load; they are designed for an overload of 25 per cent. for a period of two hours or more, and 40 per cent. for short periods. The engines were made by Messrs. J. and H. McLaren, Leeds, and are of 1,100 I.H.P. The cylinders are of 19½ in., 30½ in., and 48 in. diameter, with a 2 ft. stroke. Each engine is fitted with a fly-wheel 11 ft. 6 in. diameter, and weighing 18 tons. Surface condensers are provided, each giving a cooling surface of 1,690 sq. ft. The air pumps are of the Edwards type, 18 in. diameter, with 10 in. stroke.

Two Worthington circulating pumps have been installed; these are each capable of dealing with 610 gallons of water per minute, and are additional to three sets of the same size originally installed.

Water is pumped from the Tyne, the works being situated close on the river side, an 18-in. diameter suction pipe being laid to cope with the extra quantity of circulating water required. This pipe, which runs from the pump room, is split into two branches after reaching the foreshore, these branches being of rubber pipe 13 in. internal diameter × 10 ply thickness, and each terminates in a copper strum box. Water is pumped into three storage tanks placed on the roof, and can also be pumped direct to the condensers if required.

The main injection and discharge pipes are in duplicate and are respectively 10 in. and 12 in. diameter cast-iron.

The steam piping is of lap-welded steel and copper, the main steam ring being 9 in. diameter. Cast-steel tees have been used where branches have been taken off to the engines. All the extensions and alterations to the pipework have been carried out by Messrs. J. Abbot & Co., Ltd., Gateshead. The traction switchboard is the production of the British Thomson-Houston Co., and is of enamelled slate, mounted on an iron framework. There are three generator panels, one being a spare one at present, and four feeder panels with two feeders arranged on each panel; also the usual Board of Trade panel in the centre. At the end of the board two illuminated dial voltmeters are fixed to a swinging bracket for the bus-bar voltage. At present five feeder cables are laid, two of these being ·3 sq. in. section, and the others ·15 sq. in.; these are drawn into earthenware conduits. Three negative return cables are also laid, each ·4 sq. in. section, laid in earthenware troughing, filled with bitumen. All the feeder cables are lead covered and juted over-all.

A complete telephone installation has been provided in connection with the feeder and section pillars, thus affording ready means of communication with the power station.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

302A. "Improvements in electricity meters." Siemens Bros. & Co., Ltd. (Siemens Schuckertwerke G.m.b.H.) (Date applied for under Rule 5 of the Patents Rules, 1905, January 4th, 1906.) August 30th. (Complete.)

19,074. "Improvement in current takers for locomotors in series." L. Potterat. August 27th.

19,083. "Improvement in current breakers or commutators for internal combustion engines." V. Pendred. August 27th.

19,094. "Improved electric incandescent lamp." G. Wallace. August 27th.

19,120. "Improvements in and relating to electric motors." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 27th.

19,139. "Improvements in and relating to electric switches." E. N. Bray, F. R. Markham, and Bray, Markham & Reiss, Ltd. August 27th.

19,150. "Improvements in controllers for the trolley poles of electric cars." A. J. Edwards. August 27th.

19,219. "New or improved device for regulating or controlling the pressure of the current in an electric circuit." J. Watkinson and A. E. Payne. August 28th. (Complete.)

19,235. "Improvements in and relating to circuit protecting devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 28th.

19,239. "Improvements in the cooling of electrical machines." Allgemeine Elektricitats Aktien-Gesellschaft. (Date applied for under Patents Act, 1901, August 30th, 1905, being date of application in Germany.) August 28th. (Complete.)

19,249. "Improvements in electrical sparking devices for explosion engines." W. B. Hayden. August 28th. (Complete.)

19,255. "Improved automatic magneto-electric piano player." C. W. Wright. August 28th.

19,299. "Improvements relating to flush type electric switch mountings." P. Olver and J. W. Crawford. August 29th.

19,306. "Improvement in rods of sectional drain cleaning tools, chimney cleaning brushes and for pulling through electrical conduits and the like." G. Davis, W. Davis and S. Davis. August 29th.

19,331. "Improvements connected with supporting devices for electric fans and fittings." S. G. Leach. August 29th. (Complete.)

19,335. "Automatic adjuster for trolley ropes of electric tramcars and the like." F. Fitton and E. Milnes. August 30th.

19,368. "Metal bindings and ball bearings for strengthening knots and cuts of malaccas and other canes used for drain, chimney cleaning and electric light and telephone rods." A. Marks. August 30th.

19,373. "Improvements in electrical maximum demand meters." A. W. Brown. August 30th.

19,378. "Improvements in and relating to electric signalling for use on and in connection with railway locomotives, engines and the like." Bounevialle Signalling Syndicate and A. C. Bounevialle. August 30th.

19,386. "Improvements in telephone intercommunication systems." J. Young. August 30th.

19,387. "Electro-magnetically operated temperature regulating apparatus." F. Kaefferle. August 30th. (Complete.)

19,389. "Improvements in alternating current commutator machines." Siemens Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, August 30th, 1905, being date of application in Germany.) August 30th. (Complete.)

19,398. "Improvements in and relating to graphite filaments for use in electric lamps, furnaces or other apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 30th.

19,399. "Electro-magnetic friction clutch to control mechanically-driven musical instruments from any position." H. Jewett and E. W. Coleman. August 30th.

19,402. "Improvements in apparatus for use in clearing drains, chimneys, or for passing cables through conduits, and the like." W. J. Cox. August 30th.

19,410. "Improvements in automatic devices for cutting out faulty electrical circuits." R. J. Wallis-Jones. August 30th.

19,411. "Improvements in the electro-deposition of alloys." S. O. Cowper-Coles. August 30th.

19,413. "Sound magnifier for telegraphic instruments." F. O. Hanson and W. Schrenkler. August 30th. (Complete.)

19,431. "Improvements in chimneys and globes, for gas, electric, and oil lamps and the like." J. H. Northcott. August 31st.

19,461. "Improvement in systems of electric distribution in which vapour electric devices are employed." P. H. Thomas. (Date applied for under Patents Act, 1901, September 1st, 1905, being date of application in United States.) August 31st. (Complete.)

19,466. "Improved device for securing electrical continuity in conduit tubes and the like." H. Hirst and C. E. Gunner. August 31st.

19,467. "Improvements in adjustable carriers for electric light reflectors." H. Hirst and J. H. Collings. August 31st.

19,468. "Improvements in and relating to electric arc lamps." J. A. Rignon. August 31st. (Complete.)

19,469. "Improvements in and connected with the electric lighting of trains and other vehicles." M. E. A. Wallis and S. Sibthorp. August 31st.

19,479 "Electrolytic resistance." J. C. Schafer. August 31st. (Complete.)

19,482. "Improved system of electric ignition for explosion motors and the like." E. Eisemann. August 31st. (Complete.)

19,486. "Improvements in and relating to electro-magnetos." Belliss and Morcom, Ltd., and R. McGregor. August 31st. (Complete.)

19,548. "Improvements in and relating to electric transformers." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) September 1st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Electric Heating Cartridges. A. Voelker. 14,256. July 11th.

Telephone Systems. Lattig and Goodrum. 16,479. August 14th.

Telephone Systems. Lattig and Goodrum. 16,479A. (Date applied for under Rule 5, Patents Rules 1905, August 14th, 1905.)

Coiling Apparatus for Hollow or Solid Flexible Conductors for Gas, Electricity and the like, with Auxiliary Support for the Hollow Conductors. S. Quincey and C. Harrison. 16,491. August 14th.

Trolley Poles for Electric Traction. A. L. Prentiss. 19,504. September 27th.

Automatic Device for Use in Conjunction with the Automatic Control of Electric Arc and Incandescent Lighting Circuits. Trippe and Staniland. 20,155. October 5th.

Insulated Electric Conductors. W. T. Henley's Telegraph Works Co. and H. Savage. 22,005. October 28th.

Electric Switches. W. H. Scott. 23,751. November 17th.

Automatically Cutting Off the Current from Electrically Heated Furnaces, Stoves or other Apparatus, at any Desired Temperature. E. H. Cooper, executor of H. E. Newton, deceased. (Klewe & Co., Germany.) 23,889. November 20th.

Brush Holders for Dynamo-Electric Machines. H. W. Wilson. 24,794. November 30th.

Distribution and Supply of Current in Electric Railway Systems. Bragstad. 26,689. December 21st. (Date claimed under International Convention, December 21st, 1904.)

Controlling Electric Current Distributing Systems. J. L. Routin. 26,713. December 21st.

1906.

Apparatus Used in Electro-Plating. W. A. S. Benson & Co. and Leaver. 516. January 8th.

Sectional Ambulance Stretchers, Drain Cleaning Tools, Chimney Cleaning Tools, Pulling Through Rods for Electrical Conduits and the like. G. Davis, W. Davis and S. Davis. 1,707. January 23rd.

Trolley Wheel with Renewable Centre for Electric Tramways. J. Aldworth, L. W. Crosta and W. Boot. 2,739. February 5th.

Filament for Incandescent Lamps. S. Iseki. 3,509. February 13th.

Means for Starting Compensated Monophase Commutator Motors. Elektrische Akt.-Ges. vorm. W. Lahmeyer & Co. 6,213. March 14th. (Date applied for under International Convention, March 16th, 1905.)

Borer for Use in Planting, in Erecting Palings or Telegraph Posts, and in Sampling Soils. Bloxam. (Splettstoesser.) 8,339. April 9th.

Electrical Heating "Element" or Resistance. E. G. Rivers. 8,457. April 9th.

Overload and Reverse Current Relay Devices. Conrad. 10,172. May 1st. (Date applied for under International Convention, May 8th, 1905.)

Controlling Systems for Electric Motors. W. Cooper. 11,458. May 16th. (Date applied for under International Convention, May 22nd, 1905.)

Mounting or Supporting of Electric Motors on Electrically Propelled Vehicles. W. N. Stewart. 11,648. May 18th.

Overhead Conductors of Electric Railways and Tramways. Siemens Schuckertwerke Ges. 11,803. May 21st. (Date applied for under International Convention, June 29th, 1905.)

Brush Holders for Electro-Motors and the like. W. E. Vidal. 11,995. May 23rd.

Electrical Apparatus for Protection against Insects. A. L. M. Chaulin. 15,053. July 2nd. (Date applied for under International Convention, July 18th, 1905.)